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APPLICATIONSOFECOLOGY

# OnlineAssignment



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ECOLOGY:

Allorganisms,nomattertheirsize,theirspecies,orwheretheylive,needtointeractwith otherorganismsintheir'neighborhood'andwiththeirenvironmentinordertosurvive. Ecologyisthescientificstudyoftheinteractionsbetweenorganismsandtheir environment.ThetermcomesfromtheGreek'studyofhouse',orthestudyoftheplace welivein.

Thescopeofecologyishuge,anditencompassesallorganismslivingonEarthand theirphysicalandchemicalsurroundings.Forthisreason,thefieldisusuallydivided intodifferentlevelsofstudyincluding:organismalecology,populationecology, communityecologyandecosystemecology.Itseekstounderstandthevital connectionsbetweenplantsandanimalsandtheworldaroundthem.Ecologyalso providesinformationaboutthebenefitsofecosystemsandhowwecanuseEarth’s resourcesinwaysthatleavetheenvironmenthealthyforfuturegenerations[1].

WhoareEcologists?

Ecologistsstudytheserelationshipsamongorganismsandhabitatsofmanydifferent sizes,rangingfromthestudyofmicroscopicbacteriagrowinginafishtank,tothe complexinteractionsbetweenthethousandsofplant,animal,andothercommunities foundinadesert.

Ecologistsalsostudymanykindsofenvironments.Forexample,ecologistsmaystudy microbeslivinginthesoilunderyourfeetoranimalsandplantsinarainforestorthe ocean[1]. ApplicationsofEcology:

Themanyspecialtieswithinecology,suchasmarine,vegetation,andstatisticalecology, provideuswithinformationtobetterunderstandtheworldaroundus.Thisinformation alsocanhelpusimproveourenvironment,manageournaturalresources,andprotect humanhealth.Thefollowingexamplesillustratejustafewofthewaysthatecological knowledgehaspositivelyinfluencedourlives[1].

1)UseofEnvironmentalResources:

Ecosystemplaysaveryimportantroleinrecyclingofnutrients.Likeenergy,nutrients involvedinnutrientcyclesareneverlostorwastedfromthecycle.Excessnutrients are stored indifferentformssuchasfossilfuels,livingorganismsorCO 2.Avery importantroleplayedbymicroorganismsisthattheyfeedondeadmaterial by saprotrophicnutrition,convertingcomplexorganicmoleculestosimpleones.This conversionisacriticalpartofrecycling,enablingongoingmovementanddispersingof nutrientsacrosstheecosystem.Inthisway,theydividetheenvironmentalresources. Twomaincycleswhichareareinvolvedinrecyclingofnutrientsandtheirdivisionare carbonandnitrogencycle[2].

a)CarbonCycle:

Alllifeisbasedoncarbon.Itiscontainedinproteins,carbohydratesindeedallorganic moleculescontaincarbon.Soitisthemostimportantnutrientinanecosystem.The carboncycleinvolvesseveralstagesofcarbonbeingfixed(incorporatedaspartof)by plantsfromtheatmosphere.Thiscarbonistransferredtoconsumersbyeating,orit becomesfossilfuelinfossilization[2].



Figure1Carboncycle

b)NitrogenCycle:

Nitrogenisalsoaveryimportantcompoundforanecosystem.Despiteitsabundancein theatmosphere(79%ofairisnitrogen),itisofteninverylimitedsupply.Thisisbecause itisrequiredbyplantsasammonium(NH4+ornitrate(NO3-).Aftercarbon,nitrogenis themostimportantatominorganiccompounds.ItisparticularlyimportantinDNA,and aminoacids,whichmakeupproteins[2].



Figure2

Figure3NitrogenCycle

2)WaterShedManagement:

Watershed:Anareaoflandthatdrainswater,sedimentanddissolvedmaterialstoa commonreceivingbodyoroutlet.Thetermisnotrestrictedtosurfacewaterrunoffand includesinteractionswithsubsurfacewater.Watershedsvaryfromthelargestriver basinstojustacresorlessinsize[3].

WatershedEcology:Thestudyofwatershedsasecosystems,primarilytheanalysisof interactingbioticandabioticcomponentswithinawatershed’sboundaries.

Watershedecologyisessentialknowledgeforwatershedmanagersbecauseitteaches usthatwatershedshavestructuralandfunctionalcharacteristicsthatcaninfluence howhumanandnaturalcommunitiescoexistwithinthem.Thegrossstructureofa watershed,itsheadwatersarea,sideslopes,valleyfloor,andwaterbody,aswellasits soils,minerals,nativeplantsandanimalsareinonesensearerawmaterialforallthe humanactivitiesthatmaypotentiallyoccurtherelikeproductionofelectricityfrom dams.Thewatershed’snaturalprocessesrainfallrunoff,groundwaterrecharge, sedimenttransport,plantsuccession,andmanyothersprovidebeneficialserviceswhen functioningproperly,butmaycausedisasterswhenmisunderstoodanddisrupted.Itis crucialforpeopletounderstandwatershedsandhowtheyworkbeforetheymake decisionsortakeactionsthatmayaffectimportantwatershedstructuralorfunctional characteristics[3].

WatershedFunctions:

1)Transportandstorage(ofwater,energy,organisms,sediments,andothermaterials) Awatershedisanareathatdrainstoacommonbodyofwater,oneofitsmain functionsistotemporarilystoreandtransportwaterfromthelandsurfacetothewater bodyandultimately(formostwatersheds)onwardtotheocean.But,inadditionto movingthewater,watershedsandtheirwaterbodiesalsotransportsedimentandother materials(includingpollutants),energy,andmanytypesoforganisms.Itisimportant whenrecognizingthetransportfunctiontoalsorecognizetemporaryretentionor storageatdifferentlocationsinthewatershedandthisfunctionismainlyusedfor developmentofdamstoproduceelectricity[4].

2)CyclingandTransformation

Cyclingandtransformationareanotherbroadclassofnaturalfunctionsinwatersheds. Variouselementsandmaterials(includingwater)areinconstantcyclethrough watersheds,andtheirinteractionsdrivecountlessotherwatershedfunctions.For example(overleaf),illustratesinteractionsofthecarbonandnitrogencycleswith streambiotaandtheresultinginfluenceondissolvedoxygen.Elementslikecarbon, nitrogen,andphosphoruscomprisethewatershed’smostimportantbiogeochemical cycles.Cyclinginvolvesanelementofinterest’stransportandstorage,changeinform, chemicaltransformationandadsorption[4].

Overallwatershedmanagementstructure:



Figure4watershedmanagementstructure[4]

3)SoilConservation:

Soilisacentralcomponentofterrestrialecosystems,andafundamentalconstituentin sustaininglifeonearth.Thedegradationofsoilrepresentsalossinecosystemservices andalossofnaturalcapitalassets.Thehealthofterrestrialecosystems,definedas ecosystemintegrity,dependsontheecosystemcomponentsandthesynergyof processesamongthem.Ahealthyecosystemprovidesasteadyflowofproductionand environmentalgoodsandservices(GEF,2004),inwhichthesoilplaysakeyrole.Human over-exploitationoftheseecosystemsresultsinconsiderabledegradationcausing naturalcapitalloss[5].

Traditionalagriculturalpracticesarebasedonploughingandtillingthelandin preparationoftheseedbed.Thesepractices,however,havebeenshowntobehighly destructiveofthesoil,withtheresultthatabout24%ofglobalagriculturallandis degraded.Landdegradationreducesthesoil'sshortandlongtermproductioncapacity, andtheseareseriousconcernsconsideringthefoodproductionrequirementsof growingglobalpopulationsandaglobalGDPwhichisexpectedtotripleby2050.

Usingecology,thetraditionalapproachtosoiltillageisgraduallybeingreplacedbynew paradigmscenteredonconservingandimprovingthesoil,whileenhancingproductivity, profits,andenvironmentalbenefits.Mostoftheseapproachesarebasedonprocedures ofno-tillage,aswellasthebroaderconceptsofconservationagricultureand sustainablelandmanagement[5].

Notillage(alsocalledzerotill,directdrilling)

Underno-till,soildisturbanceisvirtuallyeliminated.Onlyatinyslotismadeduringthe plantingoperationsothattheseed(andeventuallystarterfertilizers)canbeplacedin intimatecontactwiththesoil,promotinggermination.Onlythegrainsareharvested, whiletherestoftheplant(plantmaterialotherthangrains)areleftonthesurface. Gradually,anorganicmulchisdevelopedonthesoilsurface,whichiseventually convertedtostablesoilorganicmatter.Theincreaseinorganicmatterresultsfromthe combinationofeliminatingsoildisturbance,reducingoxidationofsoilorganicmaterials (stubble),increasedbiomassproductionfromimprovedcropyields,andgreater diversityoforganicmaterialsfromincreasedrotationandcovercrops,andreduced erosion.Commonly,surfacesoiltemperaturesareslightlydepressed,whilesoilwater holdingcapacityisincreased.Theseconditionsareparticularlyimportantinthetropical andsemi-tropicalareas.Notillagecanbepracticedonbothlargeandsmallfarming systems[5].

ConservationAgriculture(CA)

CAisapplicationofecologytoimproveproductionwhileconcurrentlyprotectingand enhancingthelandresourcesonwhichproductiondepend.CAencouragesapplication ofmoderntechnologiesthatenhancethequalityandecologicalintegrityofthesoil.CA aimstoincreaselandproductivityandyieldstability,reduceproductioncostsand drudgeryinlandpreparationandmanagement,andimprovethephysical,hydrological andbiologicalqualitiesoftheland.CAisbasedonoptimizing(ratherthanmaximizing) yieldsandprofits,toachieveabalanceofagricultural,economicandenvironmental benefits.Itadvocatesthatthecombinedsocialandincreasinglyeconomicbenefits gainedfromcombiningproductionandprotectingtheenvironment,includingreduced inputandlaborcosts,aregreaterthanthosefromproductionalone.WithCA,farming communitiesbecomeprovidersofmorehealthylivingenvironmentsforthewider community[5].

Sustainablelandmanagement(SLM)

TheecologicalconceptofSustainableLandManagement(SLM)expandsonCAtoincludedimensionsof economics,markets,profitsandsustainability.SLMpromotesvalueaddedproduction,foodsufficiency, andpovertyreduction,throughimprovedcropandanimalproductionandproductioninrelationto marketopportunities.Itcanbeachievedthroughbettermanagementoffieldcrops,agroforestry, specialtycrops,andpermanentcroppingsystems[5].MaingoalsofSLMare,

maintainandenhanceproduction(productivity)

reducethelevelofproductionrisk,andenhancesoilcapacitytobufferagainst degradationprocesses(stability/resilience) protectthepotentialofnaturalresourcesandpreventdegradationofsoiland waterquality(protection)

beeconomicallyviable(viability)

besociallyacceptable,andassureaccesstothebenefitsfromimprovedland management(acceptability/equity).

4)AquaticEcology:

Aquaticecologyisabranchofthescienceofecologywhichisconcernedwiththestudy ofaquaticecosystems.Thisfieldcanbebrokenintotwodivisions:freshwaterecology andmarineecology.GiventhatmostoftheEarthiscoveredinwater,understanding aquaticecosystemsisveryimportant,especiallysincewateriscriticaltothesurvivalof alllifeonEarth.Withoutwater,Earthwouldbeaverydifferentplace,andthereprobably wouldn'tbeanyecologistsaroundtostudyit.

Freshwaterecologyinvolvesrivers,lakes,streams,seasonalbodiesofwater, undergroundwaterdeposits,andthesurroundingareas,whilemarineecologyis concernedwiththeocean.Estuaries,wherefreshwatermeetssaltwater,maybestudied byecologistsfromeitherfield,andsometimesboth,workingcooperativelyonprojects whichrequiretheexpertiseoffreshwaterandmarineecologists.Becausewater systemsareinterconnected,thereisagreatdealofcooperationbetweenprofessionals workinginvariousaspectsofaquaticecology,andbetweenaquaticecologistsand othermembersoftheecologyprofession.

Whetheranecologistworkswithsaltwaterorfreshwater,thereareanumberoftopics ofinterestinaquaticecology.Aquaticecologistsstudynaturalpopulationsof organismsinthewater,learningaboutnaturalvariationsandtheimpactofinfluences liketemperature,salinity,waterdepth,location,andseason.Ecologistsmaybe interestedspecificallyinorganismsofeconomicimportance,orinthebiologyofan ecosystemasawhole.

Aquaticecologistsarealsointerestedinhumaninteractionswiththeenvironment,and theimpactofhumanactivityonaquaticecosystems,rangingfromoilspillsintheocean toagriculturalrunoffinlakesandstreams.Somehumanactivitieshaveunintended consequences,andtheseconsequencescantakeonanepicscaleintheworldof aquaticecology,sinceallwatereventuallydrainstotheocean,andtheworld'soceans areallconnected.AmicrobeintheGangesmayendupinaharborinBritain,and ecologistscanexplorethepaththatmicrobetooktogetthere,andwhetherornot humanactivitiesplayedarole.

Thereareahugenumberoffieldsofstudyavailabletopeopleworkinginaquatic ecology,includingwaterconservation,environmentalpreservation,commercialusesof aquaticresources,pollution,thehistoryofwateruse,waterusepolicies,andthestudy ofuniqueorganismsinvariousaquaticenvironmentsallovertheworld.Oneofthe modernapplicationofaquaticecologyisprecisionfishfarming[6].

Precisionfishfarming:Anewframeworktoimproveproductioninaquaculture PrecisionFishFarming(PFF)conceptwhoseaimistoapplycontrol-engineering principlestofishproduction,therebyimprovingthefarmer'sabilitytomonitor,control anddocumentbiologicalprocessesinfishfarms.Byadaptingseveralcoreprinciples fromPrecisionLivestockFarming(PLF),andaccountingfortheboundaryconditions andpossibilitiesthatareparticulartofarmingoperationsintheaquaticenvironment, PFFwillcontributetomovingcommercialaquaculturefromthetraditionalexperiencebasedtoaknowledge-basedproductionregime.Thiscanonlybeachievedthrough increaseduseofemergingtechnologiesandautomatedsystems.Infuture,precision fishfarmingisaimedatsolvingspecificchallengesrelatedtobiomassmonitoring, controloffeeddelivery,parasitemonitoringandmanagementofcrowdingoperations [7].



Figure5Precisionfishfarming

5)Forestry:

Thestudyofforestiscalledforestry.ThedevelopingcountrieslikePakistanarefacing problemofpopulationexplosion.Thisrapidincreaseinpopulationgrowthincrease requirementsforfoodandshelter.Thereforemaniscuttingtreesforagricultureandfor woodusedinhouses.Iftheforestsarecontinuouslycutdownatthatrate,therewillbe noleafcanopyleft.Thisleafcanopyprotectsthesoilfromdrivingrain..Consequently, someofthesoilwillrunawaywithwaterandreachintothestreamandriver.Thissoil willhewasted.Thusthefertilityofthesoilwillbereduced.Therearethreeaspectsof forestry:

a)Reforestations:Clearanceofvastareasofforestforlumber,planting subsistencecropsorgrazingcattleiscalledasdeforestation.

b)Reforestation:Thereplantationoftreesinaforestiscalledreforestation.Itis necessarythatdeforestationshouldbereplacedwithreforestation.

Reforestationisespeciallyimportantformanyoftheconifersspecies.

c)Afforestation:Theestablishmentofnewforestswherenoforestsexisted previouslyiscalledafforestation.

Ecologyhelpsinreforestationandafforestation.Ecologistsaredevisingwaystostop deforestation.desertificationandovergrazing[8].



Figure6Cycleincludedinforestry

6)Wildlifemanagement:

Allnon-cultivatedplantsandnon-domesticatedanimalsareincludedinwildlife.Wild lifeplaysveryimportantroleinfoodchain.Thefoodchainisdisturbedwithoutwildlife. So.itbecomesverydifficulttomaintainthebalanceinecosystemwidiomwildlife.Man istryingtochangetheenvironment.Theeffectsofthesechangesinenvironmentare becomingmoreandmoreapparentwiththepassageoftime.Theimbalanceinwildlife canjeopardizetheexistenceofman.

Alllivingorganismsareinterdependent,Abalanceispresentbetweenlivingorganisms andenvironment.Manisdisturbingthisbalancesinceverylong.Aspeciesthatisnear toextinctioniscalledendangeredspecies.Todaytherearethousandsofendangered plantsandanimals.Wildlifeisanon-renewableresource.Ecologistsaretryingtosave theendangeredspeciesmainlydividedintotwotypes:

Manipulativemanagementinvolvesregulatingnumbersofanimalsdirectlyby harvestingorbyinfluencingnumbersbyalteringfoodsupply,habitat,densityof predatorsetc.

Custodialmanagementispreventiveorprotectiveandminimizesexternal influencesonthepopulationanditshabitat.Itisdonebysettingupnational parkswhereecologicalconditionsareprotectedandthreatenedspeciesare conservedbylaw[9].

FormsofWildlifeManagement

HabitatRestorationandManagement

Habitatmanagementisaprimarytoolwildlifebiologistsusetomanage,protect,and enhancewildlifepopulations.Increasedwildlifediversityinanareamaybeawildlife managementgoal.Itisdifficulttodevelopstrategiesformanagingeachspecies separately.Severalwildlifespeciescanbenefitwhenacompleteecosystemis improvedorpreservedintacttomeettheneedsofthreatenedorendangeredspeciesor groupsofspecies.

Managersmayenhancegrasslandareasbyclearingbrush(prescribedburning,cutting, herbicides)andremovingtrees,aswellasover-plantingthemwithnativeprairiespecies. Thishelpsreducecoverusedbyedgepredators(skunks,raccoons,red-tailedhawks) andimprovesthequalityofthehabitatforgrasslandanimals[10].

Harvest

Managersmaystrivetoreduceormaintainpopulationssoanimalsconflictlesswith humanactivities.Forexample,white-taileddeerareabundantinurbanareas.This presentschallengesforwildlifemanagersbecausehuntingwithfirearmsisnotallowed. Themosteffectivesolutionhasbeencontrolledhunts.Monkeypopulationinurban Indiacanbecontrolledbycaptureandreleaseinwildareas[10].

EndangeredSpeciesManagement

Endangeredorthreatenedspeciesrequireintensivemanagement.Criticalhabitatand locationsofexistingpopulationsmustbeidentifiedsotheycanbemanaged successfully.Ananimalspeciesisconsideredendangeredwhenitsnumbersbecome solowthatexpertsthinkitmaybecomeextinctunlessactionistakentosaveit.

Threatenedspecies’populationsareshowingsignsofunnaturaldeclineortheyare vulnerabletobecomingendangered.Manyendangeredorthreatenedspeciesare specialiststhathaveveryrestrictivehabitatneedsandeatspecializedfoods.The leadingcauseforaspeciesbecomingendangeredorthreatenedishabitatloss[10].

SpeciesReintroduction

Anotherwildlifemanagementgoalmaybetore-establishspeciesinsuitablehabitat. Thelostspeciescanbereintroducedfromotherareasonceagaininreintroduction programsandmanagementefforts.Studyofbiologyandecologicalrequirementsofthe speciesisnecessarybeforetheintroductions[10].

ConservationandPreservation

Wildlifeconservationhelpsensurefuturegenerationscanenjoyourresources.

Conservationcanincludeharvestingnaturalresources,activitiessuchashunting, fishing,trappingandharvestingtimberaswellasnon-consumptiveactivitiessuchas birdwatching,photography,andhiking.Conservationmustbalanceissuesbetween wildlifeandhumanpopulations.Conservationofwildlifeimpliesinsuringthreatenedand endangeredspeciesreceivespecialmanagementtoprotecttheirpresenceinthefuture.

Conservationmayincludepreservationorprotectionofnaturalresourcesthat emphasizesnon-consumptiveactivities.Ahabitatorecosystemcanbepreservedby manipulationandanareaalsomaybemanagedbydoingnothingatall.Forexample,a forestcanbeconservedbyallowingittomaturewithoutanyhumanmanipulationsuch astimberharvest,grazing,ortreeplanting[10].

7)Rangelandmanagement:

Thegrasslandusedbytheanimalsforgrazingiscalledrangeland.Theapplicationof scienceonrangelandforproducingmaximumnumberofgrazinglivestockregularlyis calledrangelandmanagement.Rangelandhasgreatimportance-forlivestock development.Unfortunately.manhaschangedmostoftherangelandintoagricultural land.Therefore,fewerrangelandsleftinthecountry.Theserangelandsareneededtobe protectedfromovergrazing.Overgrazingcanchangearangelandintodesert.

Theoptimumutilizationofrangelandmaintainstherangeland.Italsoprovides continuoussupplyofmilkandfleshtohumans.Maintenanceofrangelandisoneofthe applicationsofecology.Ecologicalstudiestellushowmuchpopulationofgrazera rangelandcansustain.Italsotellsusabouttheimpactofdestructionofrangelandon ecologicalcycle[8].



Figure7Rangelandclassification

8)Controlofpollution:

Thecontaminationofenvironmentwithharmfulandunwantedchemicalsiscalled pollution.Industrializationhasdestroyedourenvironment.Theseindustriesare producingahugeamountofindustrialwastes.Thosewastespolluteourenvironment. Theindustrialwastecontainsalargeamountoftoxicandcarcinogenic(cancercausing) materials.Automobilesandtanneriesproduceheavymetalslikechromium.These metalsaffectourhealth.

Ecologyhelpsustocontrolpollution.Theecologistsareusingthetechniqueof bioremediation.theremovalorthedegradationoftheenvironmentalpollutantsortoxic materialsbylivingorganismiscalledbioremediation[8].

Bioremediation:

Micro-organismsarewellknownfortheirabilitytobreakdownahugerangeoforganic compoundsandabsorbinorganicsubstances.Currently,microbesareusedtocleanup pollutiontreatmentinprocessesknownas‘bioremediation’.Bioremediationusesmicroorganismstoreducepollutionthroughthebiologicaldegradationofpollutantsintonontoxicsubstances.Thiscaninvolveeitheraerobicoranaerobicmicro-organismsthat oftenusethisbreakdownasanenergysource.Therearethreecategoriesof bioremediationtechniques:insitulandtreatmentforsoilandgroundwater;biofiltration oftheair;andbioreactors,predominantlyinvolvedinwatertreatment.

Bioremediationcanbetailoredtotheneedsofthepollutedsiteinquestionandthe specificmicrobesneededtobreakdownthepollutantareencouragedbyselectingthe limitingfactorneededtopromotetheirgrowth.Thistailoringmaybefurtherimproved byusingsyntheticbiologytoolstopre-adaptmicrobestothepollutioninthe environmenttowhichtheyaretobeadded[11].



Figure8IOTwithbio-mimicrytoreduceindoorairpollution(Bioremediation)