Chapter 17

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Appendix 17-1 Soil Erosion

(1) Soil erosion is a two-phase process consisting of the detachment of individual particles from the soil mass and their transport by erosive agents such as running water and wind. When sufficient energy is no longer available to transport the particles, a third phase deposition, occurs.

(2) Rainsplash is the most important detaching agent (Appendix 17-1(a)). As a result of raindrops striking a bare soil surface, soil particles may be thrown through the air over distances of several centimeters. Continuous exposure to intense rainstorms considerably weakens the soil. The soil is also broken up by weathering processes, both mechanical, by alternate wetting and drying, freezing and thawing and frost action, and biochemical. Soil is disturbed by tillage operations and by the trampling of people and livestock. Running water and wind are further contributors to the detachment of soil particles. All these processes loosen the soil so that it is easily removed by the agents of transport.

(3) The transporting agents comprise those which act areally and contribute to the removal of a relatively uniform thickness of soil and those which consists of rainsplash, surface runoff (Appendix 17-1(b)) in the form of shallow flows of infinite width, sometimes termed sheet flow of infinite width, sometimes termed sheet flow, and wind. The second group covers water flow in small channels, known as rills (Appendix 17-1(c)), which can be obliterated by weathering and ploughing, or in the larger more permanent features of gullies (Appendix 17-1(d)) and rivers. To these agents which act externally, picking up material from and carrying it over the ground surface, should be added transport by mass movements such as soil flows, slides and creep, in which water affects the soil internally, altering its strength.

(4) The processes of water erosion are closely related to the routes taken by water in its passage through the vegetation cover and its movement over the ground surface. Their base thus lies in the hydrological cycle. During a rainstorm, part of the water falls directly on the land, either because there is no vegetation or because it passes through gaps in the plant canopy. This component of the rainfall is known as direct throughfall. Part of the rain is intercepted by the canopy from where it is either returned to the atmosphere by evaporation or finds its way to the ground by dripping from the leaves, a component termed leaf drainage, or by running down the stem as stemflow. The action of direct throughfall and leaf drainage produces rainsplash erosion. The rain which reaches the ground may be stored in small depressions or hollows on the surface or it may infiltrate the soil, contributing either to soil moisture storage or, by percolating deeper, to groundwater. When the soil is unable to take in more water, the excess moves laterally downslope within the soil as subsurface or interflow (Appendix 17-1(e)) or it contributes to runoff on the surface, resulting in erosion by overland flow or by rills and gullies.

(5) Infiltration rates depend upon the characteristics of the soil. Generally, coarse-textured

soils such as sands and sandy loams have higher infiltration rates than clay soils because of the larger spaces between the soil particles. Infiltration capacities may range from more than 200 mm/h to less than 5 mm/h for tight clays. In addition to the role played by the inter-particle spacing or micropores, the larger cracks or macropores exert an important influence over infiltration. They can transmit considerable quantities of water so that clays with well-defined structures can have infiltration rates that are much higher than would be expected from their texture alone. Infiltration behavior on many soils is also rather complex because the soil profiles are characterized by two or more layers of differing hydraulic conductivity; most agricultural soils, for examples, consist of a disturbed plough layer and an undisturbed subsoil. Local variability in infiltration rates can be quite high because of differences in the structure, compaction, initial moisture content and profile form of the soil and in vegetation density.

(6) If rainfall intensity is less than the infiltration capacity of the soil, no surface runoff occurs and the infiltration rate equals the rainfall intensity. If the rainfall intensity exceeds the infiltration capacity, the infiltration rate equals the infiltration capacity and the excess rainfall forms surface runoff. As a mechanism for generating runoff, however, this comparison of rainfall intensity and infiltration capacity does not always hold.

(7) Effect of Plant Cover: Vegetation acts as a protective layer or buffer between the atmosphere and the soil. The above-ground components, such as leaves and stems, absorb some of the energy of falling raindrops, running water and wind, so that less is directed at the soil, whilst the belowground component, comprising the root system, contribute to the mechanical strength of the soil:

1) (Effect on rainfall): The effectiveness of a plant cover in reducing erosion by raindrop impact depends upon the height and continuity of the canopy, and the density of the ground cover;

2) (Effect on runoff): A plant cover dissipates the energy of running water by imparting roughness to the flow, thereby reducing its velocity. The level of roughness with different forms of vegetation depends upon the morphology and the density of the plants, as well as their height in relation to the depth of flow. When the flow depth is shallow, as with overland flow, the vegetation stands relatively rigid and imparts a high degree of roughness. As flow depths increase, the grass stems begin to oscillate, disturbing the flow. With further increases in flow depth, the vegetation is submerged; the plants tend to lie down in the flow and offer little resistance. Greatest reductions in velocity occur with dense, spatially uniform, vegetation covers. Clumpy, tussocky vegetation is less effective and may even lead to concentrations in flow with localized high velocities between the clumps. When flow separates around a clump of vegetation, the pressure exerted by the flow is higher on the upstream face than it is downstream, and eddying and turbulence occur immediately downstream of the vegetation. Vortex erosion is induced both upstream and downstream.

3) (Effect on air flow): Vegetation reduces the shear velocity of wind by imparting roughness to the air flow. Vegetation increases the roughness length, z_0 and raises the height of the mean aerodynamic surface by a distance, d, known as the zero plane displacement.

4) (Effect on slope stability): The fine roots, 1-20 mm in diameter, interact with the soil to form a composite material in which root fibers of relatively high tensile strength reinforce a matrix of lower tensile strength. In addition, soil strength is increased by the adhesion of soil particles to the roots. Roots can make significant contributions to the cohesion of a soil, even at low root densities and in materials of low shear strength. Grasses, legumes and small shrubs can reinforce a soil down to depths of 0.75 to 1.0 m and trees can enhance soil strength to depths of 3 m or more. The magnitude of the effect depends upon the angle at which the tree roots cross the potential slip plane, being greatest for those at right-angles, and whether the strain exerted on the slope is sufficient to mobilize fully the tensile strength of the roots. The effect is limited where roots fail by pull-out because of insufficient bonding with the soil, as can occur in stony materials, or where the soil is forced into compression instead of tension, as can occur at the bottom of a hillslope, and the roots fail by buckling. A vegetation cover should theoretically contribute to slope stability as a result of evapotranspiration producing a drier soil environment so that a higher intensity and longer duration rainfall are required to induce slope failure compared with an unvegetated slope. Also, since soil moisture depletion can affect depths well below those reached by the roots, increases in slope stability should extend some 4-6 m below ground level.

5) (Summary review): Plan covers can play an important role in reducing erosion provided that they extend over a sufficient proportion of the soil surface. Overall, forests are the most effective but a dense growth of grass may be almost as efficient and quicker to obtain. Agricultural crops vary in their effectiveness depending on their stage of growth and the amount of bare ground exposed to erosion. For adequate protection at least 70 per cent of the ground surface must be covered, but reasonable protection can be achieved with 40 per cent cover. The effects of vegetation are clearly not straightforward, however, and under certain conditions a plant cover can exacerbate erosion. When using plant covers as a basis for erosion control, it is vital that these conditions be understood and specified.

References

1. R.P.C. Morgan, Soil Erosion and Conservation 2nd ed. (1995), Longman, Essex

Appendix 17-1(a) Rainsplash Erosion

(1) The action of raindrops on soil to a given rainfall depends upon the moisture content and, therefore, the structural state of the soil, and the intensity of the rain.

1) If the soil is dry and the rainfall intensity is high, the soil aggregates break down quickly by slaking. This is the breakdown by compression of air ahead of the wetting front. Infiltration capacity reduces rapidly and on very smooth surfaces runoff can be generated after only a few millimeters of rain. With rougher surfaces, depression storage is greater and runoff takes longer to form.

2) If the aggregates are initially partially wetted or the rainfall intensity is low, microcracking occurs and the aggregates break down into smaller aggregates. Surface roughness thus decreases but infiltration remains high because of the large pore spaces between the microaggregates.

3) If the aggregates are initially saturated, infiltration capacity depends on the saturated hydraulic conductivity of the soil and large quantities of rain are required to seal the surface. Nevertheless, soils with less than 15 per cent clay content are vulnerable to sealing if the intensity of the rain is high.

(2) Studies of the kinetic energy required to detach one kilogram of sediment by raindrop impact show that minimal energy is needed for particles of 0.125 mm and that particles between 0.063 mm and 0.250 mm are the most vulnerable to detachment. Coarser particles are resistant to detachment because of their weight and clay particles are resistant because raindrop energy has to overcome the adhesive or chemical bonding forces which link the minerals comprising the clay particles. This means that soils with high percentages of particles within the most vulnerable range, for example silt loams, loams, fine sands and sand loams, are the most detachable. Selective removal of the soil particles by rainsplash can cause variations in soil texture downslope.

(3) The detachability of soil depends not only on its texture but also on top soil shear strength, a finding which has prompted attempts to understand splash erosion in terms of shear. The detachment of soil particles represents a failure of the soil by the combined mechanism of compression and shear under raindrop impact. Generally, detachment decreases exponentially with increasing shear strength.

(4) Rain does not always fall on to a dry surface. During a storm it may fall on surface water

in the form of puddles or overland flow. There is a critical water depth beyond which erosion decreases again. Once this critical depth has been reached, detachment decreases exponentially with increasing water depth because more of the rainfall energy is dissipated in the water and does not affect the soil surface.

(5) Since splash erosion acts uniformly over the land surface its effects are seen only where stones or tree roots selectively protect the underlying soil and splash pedestals or soil pillars are formed. Such features frequently indicate the severity of erosion. Splash erosion is most important for detaching the soil particles which are subsequently eroded by running water. However, on the upper parts of hillslopes, particularly on those of convex form, splash transport may be the dominant erosion process.

References

1. R.P.C. Morgan, Soil Erosion and Conservation 2nd Ed. (1995), Longman, Essex

Appendix 17-1(b) Overland Flow

(1) Overland flow occurs on hillsides during a rainstorm when surface depression storage and either, in the case of prolonged rain, soil moisture storage or, with intense rain, the infiltration capacity of the soil are exceeded. The flow is rarely in the form of a sheet of uniform depth and more commonly is a mass of braided water courses with no pronounced channels. The flow is broken up by large stones and cobbles and by the vegetation cover, often swirling around tufts of grass and small shrubs.

(2) For particles larger than 0.2 mm in diameter, the critical shear velocity increases with particle size. A larger force is required to move larger particles. For particles smaller than 0.2 mm, the critical shear velocity increases with decreasing particle size. The finer particles are harder to erode because of the cohesiveness of the clay minerals of which they are comprised unless they have been previously detached and, as a result, lost their cohesion. They can then be moved at very low shear velocities. With mixed particle sizes, the finer particles are protected by the coarser ones so that they are not removed until the shear velocity is great enough to pick up the larger particles. Counteracting this effect, however, is the action of rainsplash which may detach soil particles and throw them into the flow.

(3) Once the critical conditions for particle movement are exceeded, soil particles may be detached from the soil mass at a rate which is dependent on the shear velocity of the flow and the unit discharge. The direct application of this relationship is only valid, however, if the shear velocity is exerted solely on the soil particles, which implies that the resistance to the

flow is entirely due to grain resistance. This situation is only true for completely smooth bare soil surfaces. In practice, resistance due to the micro-topographic form of the soil surface and the plant cover is usually more important and grain resistance may be as little as 5 per cent of the total resistance offered to the flow. Since it is difficult to determine the level of grain resistance, only very generalized relationship can be developed for describing detachment rate.

(4) The effectiveness of overland flow as an eroding agent depends on its spatial extent and distribution over a hillside. The flow results from the rainfall intensity being greater than the infiltration capacity of the soil and is distributed over the land surface in the following pattern. At the top of a slope is a zone without flow which forms a belt of no erosion. At a critical distance from the crest sufficient water has accumulated on the surface for flow to begin. Moving further downslope, the depth of flow increases with distance from the crest until, at a further critical distance, the flow becomes concentrated into fewer and deeper flow paths which occupy a progressively smaller proportion of the hillslope. Hydraulic efficiency improves allowing the increased discharge to be accommodated by a higher flow velocity. Nevertheless, the hydraulic characteristics of the flow vary greatly over very short distances because of the influence of bed roughness associated with vegetation and stones. As a result, erosion is often localized and after a rainstorm the surface of a hillside displays a pattern of alternating scours and sediment fans. Eventually, the flow breaks up into rills. That overland flow occurs in such a widespread fashion has been questioned, particularly in well-vegetated area where such flow occurs infrequently and covers only that 10 to 30 per cent of the area of a drainage basin closest to the stream sources. Under these contditions its occurrence is more closely related to the saturation of the soil and the fact that moisture storage capacity is exceeded rather than infiltration capacity.

References

1. R.P.C. Morgan, Soil Erosion and Conservation 2nd Ed. (1995), Logman, Essex

Appendix 17-1(c) Rill Erosion

(1) As indicated earlier, it is widely accepted that rills are initiated at a critical distance downslope where overland flow becomes channeled. In addition to the main flow path downslope, secondary flow paths are developed with a lateral component. Where these converged, the increase in discharge intensified particle movement and small channels or trenches are cut by scouring. Studies of the hydraulic characteristics of the flow show that change from overland flow to rill flow passes through four stages; unconcentrated channel

flow, overland flow with concentrated flow paths, micro-channels without headcut and micro-channels with headcuts. The greatest differences exist between the first and second stages, suggesting that the flow concentrations within the overland flow should strictly be treated as part of an incipient rill system. In the second stage, small vortex appear in the flow which, in the third stage, develop into localized spots of turbulent flow characterized by roll waves and eddies. At the point of rill initiation, flow conditions change from subcritical to supercritical. Although headcuts or knick points may form at this time and all rills are associated with headcut development, not all headcuts develop into rills.

(2) As expected from its considered erosive power, rill erosion may account for the bulk of the sediment removed from a hillside, depending on the spacing of the rills and the extent of the area affected.

References

1. R.P.C. Morgan, Soil Erosion and Conservation 2nd Ed. (1995), Longman, Essex

Appendix 17-1(d) Gully Erosion

(1) Gullies are relatively permanent steep-sided water courses which experience ephemeral flows during rainstorms. Compared with stable river channels which have a relatively smooth, concave-upwards long profile, gullies are characterized by a headcut and various steps or knick-points along their course. These rapid changes in slope alternate with sections of very gentle gradient, either straight or slightly greater depth and smaller width than stable channels, carry larger sediment loads and display very erratic behavior so that relationships between sediment discharge and runoff are frequently poor. Gullies are almost always associated with accelerated erosion and therefore with landscape instability.

(2) At one time it was thought that gullies developed as enlarged rills but studies in the gullies revealed that their initiation is a more complex process. In the first stage small depressions or knicks form on a hillside as a result of localized weakening of the vegetation cover by grazing or fire. Water concentrates in these depressions and enlarges them until several depressions coalesce and an incipient channel is formed. Erosion is concentrated at the heads of the depression where near vertical scarps develop over which supercritical flow occurs. Some soil particles are detached from the scarp upslope. Sediment is also produced further down the gully by bank erosion. This occurs partly by the scouring action of running water and the sediment it contains and partly by slumping of the banks following saturation during flow. Between flows sediment is made available for erosion by weathering and bank collapse.

(3) Not all gullies develop purely by surface erosion, however. For Gullies which were formed following clearance of natural forest cover, most water was removed from the hillsides by subsurface flow in natural pipes or tunnels and when heavy rain provided sufficient flow to flush out the soil in these, the ground surface subsided, exposing the pipe network as gullies. Numerous studies recorded the formation of gullies by pipe collapse in many different materials and climatic environments. The essential requirements are steep hydraulic gradients in a soil of high infiltration capacity through macropores but low intrinsic permeability so that water does not move readily into the matrix.

(4) A third way in which gullies are initiated is where linear landslides leave deep, steep-sided scars which may be occupied by running water in subsequent storms.

References

1. R.P.C. Morgan, Soil Erosion and Conservation 2nd Ed. (1995), Longman, Essex

Appendix 17-1(e) Subsurface Flow

(1) The lateral movement of water downslope through the soil is known as interflow. Where it takes place as concentrated flow in tunnels or subsurface pipes its erosive effects through tunnel collapse and gully formation are well kwon. Less is known about the eroding ability of water moving through the pore spaces in the soil, although it has been suggested that fine particles may be washed out by this process. The material, uniformly fine with particles ranging from 4 to 8 μm in diameter, was being detached by the flow through the macropores in the soil.

References

1. R.P.C. Morgan, Soil Erosion and Conservation 2nd Ed. (1995), Longman, Essex

Appendix 17-2 Pasture lands

(1) Since grass provides a dense cover, close to the soil surface, it is a good protector of the land against erosion. Erosion problems arise only when this cover is removed through overgrazing, although they can be exacerbated by drought and excessive burning. Erosion control depends largely on the use of agronomic measures. These are directed at determining and maintaining suitable stocking rates, although this can be difficult if not impossible in areas where people attach cultural and social value to the size of their herds, and at planting erosion-resistant grasses and shrubs. The latter are characterized by vigorous growth, tolerance of drought and poor soils, palatability to livestock and resistance to the physical effects of trampling. Specialized measures designed to increase the resistance of the soil may be required around field gates, watering points and salt boxes. Traditional grazing systems are often well-adapted to the local conditions of climate, soils and vegetation, making use of rotational grazing on a nomadic basis.

(2) Virtually all traditional grazing systems are under pressure today. First, human population numbers, as a result of better health, and livestock numbers, as a result of better veterinary services, are both increasing. Second, there is a conflict between the individual and family ownership of livestock and the communal ownership of the pasture. The individual derives a positive utility of almost one for every additional animal owned and grazed on communal land and experiences a negative utility of only a small fraction of one as a result of ensuing overgrazing, The maximization of individual benefit at the expense of the community is one of the biggest challenges facing soil conservationists on rangeland. The conflict becomes mist marked when incentives for commercial livestock production are so strong that individuals, usually those owning the larger numbers and better quality stock, break away and take over much of the land, enclosing it by fencing, displacing other members of the community and increasing the pressure on the remaining range. Third, the provision of additional watering points, often located without consideration of the traditional movement of stock, has meant that availability of forage rather than water has become the limiting factor on livestock numbers, creation additional pressure on the land. Fourth, the concentration of people in settlements to provide health, education and water more efficiently and to promote cash cropping with irrigation has caused people to abandon their nomadic tradition with the result that stock are kept all year on the pastures close to the homestead. Sometimes new settlement schemes will be sited on seasonal grazing areas, thereby removing them from the system. Fifth, education of the youth and changed political systems are gradually eroding the authority of the elders. Grazing can be considered as the removal of biomass from rangeland. The rate of removal depends upon the number of animals and their daily intake of forage. Soil conservation is therefore aimed at controling grazing numbers so that a sufficient vegetation

cover is sustained over time to protect the soil.

(3) Loss of vegetation increases the rate of runoff and erosion and decreases the amount of water in the soil which, in turn, reduces the amount of vegetation growth. In reality, the vegetation-erosion-grazing interaction is more complex because of the need to consider soil fertility, loss of soil nutrients, production of litter, the palatability and digestive value to stock of the different species in the plant community, and the ability of the different species to survive under changing grazing, moisture and nutrient conditions. At present, the interaction is poorly understood. Clearly with such a discrepancy between conventional wisdom and model predictions, it is difficult to determine the safe level of grazing, particularly when short-term fluctuations in climate also need to be considered. Further, there may be a conflict between designing a strategy at which the sustained productivity of the rangeland and erosion remain in balance and which may therefore maximize economic benefit over the medium- to long-term but keeps erosion rates relatively high, and a strategy which maintains erosion below a much lower tolerable level to minimize environmental impacts.

(4) Grazing animals are well known for their ability to cause compaction, or poaching, especially during wet conditions. It is particularly common to find poorly drained or puddled areas in the vicinity of food troughs or gateways where animals tend to congregate. Compaction has adverse effects on a number of soil characteristics. Increased bulk density and the consequent decrease in porosity are associated with both increased waterlogging and poor aeration; these changes in turn have a detrimental effect on the thermal characteristics of soils. Under these conditions, plant growth may be restricted, particularly during the early stages of germination and emergence, and during the main phase of root network development. Grazing as a landuse practice involves the rearing of animals mainly for transport, meat, milk or wool.

References

1. S.Ellis and A.Mellor, Soils and Environment (1995), Routledge, New York

Appendix 17-3 Forest and Woodlands

(1) Forest provide excellent protection of the soil against erosion. They maintain high rates of evapotranspiration, interception and infiltration and therefore generate only small quantities of runoff. Low runoff rates and the protective role of the litter layer on the surface of the soil produce low erosion rates. Increases in erosion occur where the land is permanently or, in the case of sifting cultivation, temporarily cleared for agriculture. The most important erosion problems are associated with cropping of the trees for firewood; destruction of the trees and surrounding shrub and ground cover by grazing; and logging operations. Livestock grazing is frequently detrimental to the survival of forests. The animals trample and compact the soil, injure roots close to the surface and browse on the tree seedlings. Logging causes limited disturbance because erosion is confined to the area of land where the trees have been removed. With good management, the vegetation cover regenerates quickly so that high erosion rates are restricted to the first and sometimes the second and third years after felling. The level of disturbance is related to the method of clearance.

References

1. S.Ellis and A.Mellor, Soils and Environment (1995), Routledge, New York

Appendix 17-4 Cultivated Land

(1) Methods of arable cultivation have evolved in different ways in response to the vast array of contrasting global environments. In temperate areas, land has often been more closely settled, and competition for land has been greater, than in tropical regions. Furthermore, land in temperate areas cannot be cropped for significant periods of the year, due to the restricted growing season, and consequently more intensive cropping systems have evolved. Here, grass-clover pasture, root crops and cereals were alternated, and arable practices were closely integrated with livestock rearing. The nitrogen for crop growth could therefore be fixed in the soil by clover, which is a legume, and released from grass residues and manure.

(2) In recent decades, due largely to increasing population pressure, demand for food and competition between different land uses, there has been a move away from the more traditional agricultural practices outlined above, in both tropical and temperate regions. During the Second World War in particular, the demand for food increased and agricultural activity intensified. Arable and livestock rearing became increasingly separated. At this time, greater emphasis was placed on cereal monoculture at the expense of arable-ley rotations. This change became feasible as the traditional sources of nitrogen were replaced by inorganic nitrogen fertilisers. However, excessive use of such fertilisers led to increased soil acidification, and to nutrient enrichment of runoff from agricultural land with consequences for surface water quality and aquatic biota

(3) In addition to the chemical changes, the intensity and scale of mechanization in arable cultivation has increased dramatically. This has contributed to increased soil compaction which in turn has led to impeded drainage and restricted development of plant root networks. In an attempt to overcome these problems, minimum and zero-tillage options have been developed, where the use of heavy agricultural machinery is minimized.

References

1. S.Ellis and A.Mellor, Soils and Environment (1995), Routledge, New York

Appendix 17-5 Construction and Demolition (C& D) Wastes

(1) The largest percentage of waste delivered to municipal disposal facilities consists of excavated material, and building and road construction (debris C&D wastes) in many developed countries. Of this waste, the majority continues to be landfilled. In recent years, numerous intensive measures to increase construction material recycling have been unable to significantly raise recovery and reutilization rates. Strong pressure still exists to merely landfill construction debris.

(2) The materials that comprise C&D wastes are divided into separate waste group:

1) Excavated Materials: Excavated material is generated during almost all construction activities, including irrigation or drainage ditch construction, road construction, and residential and commercial construction. The two types of excavated materials are clean (uncontaminated) and contaminated material. Depending on waste purity and composition, excavated material can be used directly for subgrade road construction or landfill cover; roads or noise protection embankments; horticulture; or it can be delivered to a screening facility. Contaminated excavated material, often generated at construction projects in established industrial parks, abandoned industrial sites, railroad yards, airports, etc., must be closely monitored and properly disposed of to protect the public welfare and the environment.

2) Construction Debris: Construction debris is generated during building and below-grade construction. Depending on the age and design of the structure, construction debris can have a varied composition and can be altered or contaminated by organic and inorganic substances. Construction debris is divided into three categories: clean, altered, and contaminated.

a) Clean construction debris is the detrital mineral matter (e.g., limestone, mortar) accumulated during building demolition (i.e., demolition with Systematic Deconstruction). This material contains only minimal amounts of organic and inorganic foreign particles (e.g., soil, sand, cement without bricks, and natural stone) and can be classified as artificial rock.

b) Altered construction debris results from building demolition without systematic deconstruction. Any associated impurities can be sorted or screened and can be disposed of. The impurities in construction debris are those solid components of the building that were in functional association with the building, such as plumbing, flooring, wall, and ceiling panel materials. Disposal of construction debris with up to 10% (by volume) of these materials is allowed by municipal waste disposal statutes.

c) Contaminate construction debris is defined as containing substances that are harmful to water, soil, or public health. These materials could also have a harmful effect on the environment depending on their contaminant concentrations. These material usually accumulate after the demolition of industrial buildings or structures, or paved areas or as a result of fire damage. Contaminated waste must be closely monitored and properly disposed

of to protect the public welfare.

3) Construction Site Debris: Construction site waste (a broader term than the construction debris) includes all extraneous materials from building construction, expansion, or renovation. Construction site waste can include wood, ferrous and nonferrous metals, plastics, paper, cardboard, organic, bulky, and hazardous waste (paints, lacquers, etc.). Only the mineral component of these wastes is recyclable after separate collection and subsequent sorting. Nonrecyclable foreign components and components containing toxic substances are defined as "residual construction waste".

References

1. B.Bilitewski, G.Hardtle and *et al*, Waste Management (1994), Springer-Verlag, Berlin

Appendix 17-6(a) Trees around the Project Sites

1. Aspen (*Populus*)
Japanese name (general): Hakoyanagi

Salicaceae
A non-coniferous (leafy) tree attaining up to 30 m in height
Distribution: Khubsugul, Khentei, Khangai, Mongol Daurian, Middle Khalkha
Habitat: Aspen grows within the bounds of the forest belt in birch woods and birch groves, along the river and rivulet banks, on wooded and rocky slopes

Sites: 10pk6-10pk8, 17pk9-19pk2, 208-209km, 244-245km, 285km, 289km

2. Asian White Birch (*Betula platyphylla*)
Japanese name: Shirakanba

Betulaceae
A broad leaved deciduous tree. It attains up to 27 m in height.
Distribution: Khubsugul, Khentei, Mongol Daurian, Great Khingan
Habitat: The tree forms small woods and grooves by mountainou slopes, in river valleys, and also it grows in larch, siberian pine-larch, sylvan pine woods.

Sites: 10pk6-10pk8, 17pk9-19pk2, 272km, 285km

3. Siberian Larch (*Larix sibirica*)
Japanese name (general): Karamatsu

Pinaceae
A deciduous tree reaching 20-30 m in height.
Distribution: Khubsugul, Khentei, Khangai, Mongol Daurian, Khobdo, Mongolian Altai, Depression of Great Lakes, Dzungarian Gobi
Habitat: In mountain slopes as a forest forming species, valleys of a river.

Sites: 272km, 285km, 289km, 420-421km

4. Siberian Pine (*Pinus sibirica*)
Japanese name (general): Matsu

Pinaceae
An ever-green tree reaching 26-30 m in height
Distribution: Khubsgul, Khentei, Khangai, Mongolian Altai
Habitat: Mountain forests chiefly in upper parts of forest belt

Sites: 235km, 244-245km, 255km, 272km, 285km, 289km

5. Siberian Elm (*Ulmus pumila*)
Japanese name (general): Nire

Ulmaceae
A deciduous tree reaching 2-12 (15) m in height.
Distribution: Khubsugul, Khentei, Khangai, Mongol Daurian, Mongolian Altai, Middle Khalkha, East Mongolia, East Mongolia, East Gobi, Gobi Altai, Alashan Gobi
Habitat: Stony and rocky slopes of mountain, bottoms of Creek valley, sides and bottoms of a dry riverbeds, outskirts of wellhead, sands and stony slopes in valleys of rivers, light pine forest on sands.

Sites: 10pk6-10pk8, 17pk9-19pk2, 30-32km, 65-69km,

6. Willow (*Salix*)
Japanese name: Yanagi

Sites: 10pk6-10pk8, 17pk9-19pk2, 54-56km, 65-69km, 208-209km, 223km, 285km, Dund river (park, Ulaan-baatar)

References

1. U. Ligaa, Medicinal Plants of Mongolia Used in Mongolian Tradition Medicine (1996), Seoul
2. Report of the Environmental Study (1996), Monmap Engineering and ENCO, Ulaan-baatar

Appendix 17-6(b) Rare Plant Species around the Project Sites

1. Macrophyllous Gentian (*Gentiana macrophylla*)
Gentianaceae

A perennial herbaceous plant reaching 20-65 cm in height.
(Distribution) Khubsugul, Khentei, Khangai, Mongol Daurian, Mongolian Altai, Khobdo, Great Khingan
(Habitat) Large leave gentian grows in larch and mixed forests, meadows, meadow slopes, at the bottom of creek valleys, and by lake, river and brook banks.

A very rare plant listed in the Mongolian Law on Nature Plants

Sites: 54-56km, 92-96km, 272km, 285km, 289km, 465km

2. Mongolian Adonis (*Adonis mongolica*)
Ranunculaceae

A perennial herbaceous plant reaching 25 cm in height.
(Distribution) Khubsugul, Khangai, Mongol Daurian
(Habitat) Mountainous steppes and plains of different herbs.

A very rare plant list in the Mongolian Law on Nature Plants
A plant Listed in the Mongolian Red Data Book (1996)

Sites: 434-435km

3. Dichotomous Star (*Stellaria dichotoma*)
Caryophyllaceae

A perennial herbaceous plant reaching 15-30 cm in height.
(Distribution) Khubsugul, Khentei, Khangai, Mongol Daurian, Great Khingan, Khobdo, Mongolian Altai, Middle Khalkha, East Mongolia, Depression of Great Lakes, East Gobi, Gobi Altai
(Habitat) Dry, rubbly, stony steppe slopes, screes, rocks, seldom pebbly grounds and sands.

A plant listed in Gov. Res. 153
A plant listed in the Mongolian Red Data Book (1996)

Sites: 10pk6-10pk8, 17pk9-19pk2, 30-32km, 54-56km, 65-69km, 92-96km, 170km, 208-209km, 255km, 335km, 358km, 399km

4. Chickweed (*Stellaria media*)
Caryophyllaceae

A plant listed in Gov. Res. 153

Sites: 30-32km, 208-209km, 255km, 399km, Dund river (park, Ulaan-baatar), 429-430km, 434-435km

5. Siberian Pine (*Pinus sibilica*)
Pinaceae

An ever-green tree reaching 26-30 m in height.
(Distribution) Khubsugul, Khentei, Khangai, Mongolian Altai
(Habitat) Mountain forests chiefly in upper parts of forests belt.

A plant listed in Gov. Res. 153

Sites: 235km, 244-245km, 255km, 272km, 285km, 289km

6. Daurian Sweetbech (*Hedisarum dauricum*)
Leguminosae

A plant listed in Gov. Res. 153

Sites: 10pk6-10pk8, 17pk9-19pk2

7. Mongolian Bluebeard (*Caryopteris mongolica*)
Verbenaceae

An undershrub reaching 0.5 m in height.
(Distribution) Khangai (East), Khentei (West), Mongol Daurian, Mongolian Altai, Middle Khalkha, East Mongolia (South), Valley of Lakes, East Gobi, Gobi Altai, Transaltai Gobi, Alashan Gobi
(Habitat) Steppe and desert stony and rubbly slopes of hills and mountains, on rocks, along sandy-rubbly bottoms of dry riverbeds, river spits (shallow), on weak sands.

A plant listed in the Mongolian Red Data Book (1996)

Sites: 208-209km

8. Seabuckthorn (*Hippophae rhamnoides*)
Elaeagnaceae

A broad leave deciduous shrub or a little tree 1.0-2.5 m in height.
(Distribution) Khangai, Mongol Daurian, Khobdo, Mongolian Altai, Depression of Great Lakes, Valley of Lakes, Gobi Altai
(Habitat) Banks of rivers and lakes, on pebbly riversides, outskirts of woods and on canyon slopes.

A plant listed in the Mongolian Red Data Book (1996)

Sites: 17pk9-19pk2, 30-32km

References

1. U. Ligaa, Medicinal Plants of Mongolia Used in Mongolian Traditional Medicine (1996), Seoul
2. Report of the Environmental Study (1996), Monmap Engineering and ENCO, Ulaan-baatar

Appendix 17-7(a) Fishes around the Project Sites

1. Baikal Sturgeon (*Acipenser baeri*)
Japanese name (general): Chouzame
Mongolian name: Baygaly Nuuruin Khilem

Stuegeons and Paddlefishes (Acipenseriformes) are the single order in superorder Chondrostei. The body is elongated and spindle-shaped and the snout is more or less extended. The mouth is on the lower side of the head and is toothless or in the young has very small teeth. An upper jaw bone is present. The skin is nearly naked (in paddlefishes) or has five rows of large bony plates (true sturgeon); scales are only on the upper edge of the heterocercal caudal fin. The skeleton is primarily cartilaginous, with an intact notochord (Chorda dorsalis); vertebrae are not developed. Even the skull is cartilaginous, and in adults it bears a strong bony covering. Spiracles may be present or absent. Respiration occurs through the gills with five gill slits. Of the gill cover bones only the operculum is present. The foregut is short and is connected with the simple swim bladder by an air passage. The stomach has a strong musculature and the connecting intestine has a well-developed spiral valve. There are two families: 1. Sturgeons (Acipenseridae); 2. Paddlefishes (Polyodontidae). A third family is now extinct.

The Sturgeon family Acipenseridae contains the world's largest fresh water fishes. This family has existed for about 200 million years and consists of fresh water and migrant species prevalent in the northern hemisphere, which can be recognized by the following characteristics: Five lateral rows of bony plates (which differ among various species in form, size and number), between which in some species small bony platelets are embedded in the skin at irregular intervals; the plates of the young are closer to each other , more strongly developed, and with a sharp keel terminating in a thorny projection. The mouth has thick wart-covered lips and can have a trunklike projection. Small soft teeth are found in the young of genus *Acipenser* and in no other sturgeon; their form and placement differs among the various species. The dorsal, anal and pectoral fins are located well to the rear. Coloration is generally olive green, brownish or gray on the back, and the underside of the lateral scales is white. Two subfamilies exist: 1. Sturgeon (Acipenserinae), with spiracles and a pointed snout; 2. Shovel-nosed sturgeon (Scaphirhynchinae), lacking spinacles and with a wide, shovel-shaped snout.

The sturgeon subfamily Acipenserinae contains the genera *Huso* with two species and *Acipenser* with seventeen species. One means of distinguishing the two genera is by the shape of the mouth and the mouth barbs; in *Huso* the large, half-moon shaped mouth opening extends to the end of the snout and the barbs are flattened, while in *Acipenser* the mouth does

not extend to the end of the snout and the barbs are rounded.

The two species found in the far eastern Soviet Union, the Siberian Sturgeon (*Acipenser bareri*; L exceeds 2 m, weight up to 200 kg) which inhabits Siberian rivers from the Ob to the Kolyma, and the Amur Sturgeon (*Acipenser schrencki*: L up to 2.9 m, weight 80-160 kg, rarely 200 kg), are both migration species. They resemble each other structurally; the Amur Sturgeon is somewhat more slender. In some large lakes and rivers varieties have developed which do not migrate into the sea any longer. An example of this is the Siberian Sturgeon population in Lake Baikal.

"Very Rare" in Mongolian Law on Hunting
Listed in Mongolian Red Data Book (1996)
Prohibited fishing

2. Taimen (*Hucho taimen*)
Japanese name (general): Itou
Mongolian name: Tul

The order Salmoniformes consists of eight suborders, with some quite unlike others. The last five consist almost exclusively of deepsea fishes: 1. Salmon (Salmonoidei) with three families; 2. Galaxiids (Galaxioidei) with four families; 3. Pike (Exocoidei) with two families; 4. Argentines (Argentinoidei) with three families; 5. Stomiatoids (Stomiatoidei) with eight families; 6. Deepsea slickheads (Alepocephaloidei) with one family; 7. Deepsea smelts (Bathylaconoidei) with one family; 8. Lanternfishes (Myctophoidei), with fifteen families.

Salmonoidei contains a number of the most well-known species of this fish order. A rayless dorsal fin is always present; oviducts are absent or are incompletely developed. These are primarily migration species and fresh water fishes of the northern hemisphere. Breeding takes place in cold, oxygen-rich water. There are three families present today: 1. Salmon with three subfamilies; 2. Ayu; 3. Smelt. There is also one extinct family, the thaumaturids (+ Thaumaturidae; Middle Eocene to Lower Pliocene, 40 to 25 million years ago).

Many of the salmon species are good eating not only because of their flavorful, fatty meat but also because they lack those bones which in most fishes are embedded in the cartilaginous walls between the muscular segments.

Salmonidae contains such familiar fishes as salmon, trout, and charrs. Medium-sized fish,

these species are rounded with numerous small scales (with generally more than 120 in the fully developed lateral line). The mouth opening is wide and has powerful teeth. The vertebral column arches upward at the base of the caudal fin. There are three subfamilies: A. Salmon; B. Whitefishes; C. Graylings.

The salmon subfamily (Salmoninae) contains five genera: 1. Salmon (*Salmo*, which also contains trout); 2. Pacific salmon (*Oncorhynchus*); 3. *Hucho*; 4. Charr (*Salvelinus*); 5. *Brachymystax*. Many of the species tend to form local populations, so that classification is often difficult.

One of the largest freshwater fishes is the salmon genus *Hucho*, closely related to charr. They have a short vomer. The vomerine teeth and palate form a closed row. These are particularly elongated fishes which are compressed only slightly along the sides. In cross-section they are also round. The head is somewhat flattened as in pike. There are three species, including the Danube Salmon (*Hucho hucho*) and *Hucho taimen*.

Danube Salmon (*Hucho hucho*) is known as the redfish in southeastern Alpine countries because of its red display coloration. It is sometimes confused with the sturgeon genus *Huso*. Today it is a rare species. The only evidence of its once great prevalence are older reports of the "Danube salmon". Once they were commonly caught with a L of 60-120 cm (15-year old specimens were up to 1.5 m long) and weight of as much as 52 kg. *Hucho taimen* is still larger; it inhabits European-Asiatic waters from the Volga and Petschora eastward to the Amur. This species attains a weight of 30-60 kg, sometimes 80 kg.

Listed in Mongolian Red Data Book
Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, 65-69km, 208-209km, 223km, 244-245km, 255km, 272km, 285km, 289km

3. Lenok (*Branchymystax lenox*)
Mongolian name: Zevge

The closest relative of the Danube Salmon is the Lenok (*Brachymystax lenox*), the only member of its genus. It occupies a distinct position within salmon group; while all other species have wide mouth openings, the lenok is distinguished by a small mouth which does not extend beyond the rear edge of the eyes. Lenok are prevalent in the Siberian rivers from

the Ob to the Kolyma and on the Asiatic Pacific coast southward to Yaru River. Lenok is found especially in waters just before mountain ranges. The diet consists of May fly larvae, amphipods and other bottom dwellers. In the Amur it feeds on great quantities of dog salmon eggs when that species is spawning, and later it preys upon the young dog salmon. In some parts of Siberia the lenoks are the most important commercial fish. They attain a maximum weight of 3-4 kg, rarely 6 kg.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, 65-69km, 208-209km, 223km, 235km, 244-245km, 255km, 272km, 285km, 289km

4. Siberian Grayling (*Thymallus arcticus*)
Japanese name: Kawahimemasu
Mongolian name: Sibiriyn Khadran

The Graylings (Thymallinae; the single genus is Thymallus) are medium-sized fishes with a prominent large dorsal fin. The mouth is narrow and has small, well-developed teeth. The scales are relatively large. Graylings have an odor resembling thyme. There are five species and many subspecies.

In their distribution, which extends over wide parts of Eurasia and North America, graylings live in localized areas in clear, fast-flowing water. Since they are not as sensitive to water temperature as river trout and feed on streaming aquatic plants in deep pools, they primarily are found in water below the river trout region, which is therefore designated as the "grayling region". However, in the upper courses of rivers, they are found together with river trout. They avoid mountain rapids. In some Alpine lakes they are only found at the mouths of streams where the water still flows. Pure lake varieties are found in a few Scandinavian and Siberian lakes, in some cases as the only fish in those lakes. Graylings are found in brackish water along the Swedish and Finish cliffed shores.

European Grayling (*Thymallus thymallus*)

All European graylings belong to one species, the European Grayling (*Thymallus thymallus*). Graylings grow fairly quickly. After two years they measure 15-20 cm, with a maximum L of 50 cm and a weight of 2-3 kg. Such specimens can live to be seven to fourteen years of age.

Some Alpine rivers once contained graylings one meter long, weighing ten kilograms. Graylings, unlike river trout, are often found in small groups. They feed on the larvae of caddis flies and May flies, which they grab from the stones on the river bed. Other food includes the amphipod *Rivulogammarus pulex*, snails, mussels and other organisms. They seize flying insects in the air. They also feed on salmon and trout eggs which are either floating through the water or are in the open on the bottom, but graylings have never been observed digging up the ground to get at eggs, so it cannot be said that they ruin the spawn. Larger graylings also feed on smaller fishes and small mammals. But otherwise they are a peaceful species.

Graylings spawn in the spring. According to the prevailing water temperature they reach sexual maturity in March or as late as May as two- to three-year old fishes. They resemble salmon in their spawning behavior. They do not generally undertake spawning migrations, however. The northern lake inhabitants spawn either on shallow shore sites in the lakes themselves or they ascend short distances up the tributary rivers. During the spawning period members of both sexes are colored darker and more brilliantly. The entire body has a light red shimmer. Rows of distinct purple eye spots appear on the dorsal fins. The males are characterized by thickening of the skin on the sides of the back and tail. As in salmon and trout the female grayling digs the spawning pit herself; it is located on shallow sites with a gravel floor. Rivalry fights typically break out among the males, but they are not carried out with the vigor which characterizes those rituals in salmon. Whilst releasing eggs and sperm both partners stir up the water and bottom soil with powerful beats of their tails. This mixes the eggs and sperms; furthermore the sticky eggs thus come into contact with the floor at once, to which they adhere and sink into the spawning pit. Depending on the size of the female, 3000-6000 eggs 3-4 mm in diameter are laid; they are covered in the spawning pit with gravel. The small yolk sac is eaten shortly after the young hatch, and the young grow relatively quickly; after one summer they are 7-12 cm long. Like salmon and trout they have a distinctive juvenile coloration with a row of dark spots along the lateral line.

Graylings are very popular with sport fishermen, for they put up a good fight when they are hooked. They are also popular for eating. However they do not have great commercial importance since they cannot after their death. Unfortunately graylings have becomes uncommon and have completely disappeared from some former grayling waters, since the species is very sensitive to pollution.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, 65-69km, 208-209km, 223km, 235km, 244-245km,

255km, 272km, 285km, 289km

5. Northern Pike (*Esox lucius*)
Japanese name: Kawakamasu
Mongolian name: Tsurkhay

The pike suborder Esocoidei has a mouth lacking the movable premaxillaries and a toothless upper jaw (maxillary); the three skull bones known as the mesocoracoid, orbitosphenoid and mesethmoid are absent. There are two families: pikes (Esocidae) and mudminnows (Umbridae), the latter containing the blackfish, which were once considered to be an individual family Daliidae, and the Olympic mudminnow once classed as Novumbridae.

Pike (Esocidae) have a long snout which resembles that of a duck bill. The joint of the lower jaw is behind the rear edge of the eye. The Northern Pike (*Esox lucius*) inhabits flowing and standing water throughout Europe with the exception of Spain, southern Italy and Dalmatia; it is also found in Siberia and North America. The Northern Pike is a powerful predator which can reach a considerable size.

When the solitary pike lies in wait for prey, it sits quietly in the upper water levels at the edge of plants in order to grab passing fishes with a rapid, darting movement which is usually headfirst.

In addition to fishes pike also prey upon rats, mice, birds, frogs and other small vertebrates. Since they feed on commercially worthless minnows and carp (Cyprinidae), which then become converted into valuable pike flesh, the pike is a popular fish for eating and is even bred for this purpose. Four to five grams of minnow meat suffice to produce one gram of pike meat. The pike spawning period occurs in the first spring months, approximately from March to May. The fishes move into meadows which have been flooded by the high spring waters. During this time the otherwise very cautious fishes are easy to observe; there are generally one large female and two to three smaller males. The sticky spawn adheres to objects and plants, perhaps on the feet and wings of birds as well. By this mechanism pike get carried into small bodies of water where their presence would otherwise be completely unexplainable. The number of eggs laid varies depending on the size of the female between 100,000 and 1,000,000. Often pike are bred in artificial stations and the young are then placed into natural waters. The young pike initially feeds on plankton, but when three to four cm long changes to a fish diet. Of a group of young pike in an aquarium there will soon be just one animal surviving, this one having eaten all its brothers and sisters.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, 65-69km, 208-209km, 223km, 235km

6. Siberian Roach (*Rutilus rutilus*)
Mongolian name: Altan Zagas

The carp suborder Cyprinoidei is characterized by the following characteristics: the jaw and other mouth bones lack teeth; a lower pharyngeal bone is sickle-shaped and has one to three rows of teeth; the mouth protrudes prominently; barbs are often present; the fins are well developed, but there is no adipose fin. Most species have scales, the head and gill cover being naked. All four gill cover bones are present. The swim bladder is divided by constrictions into two or three chambers but lacks an inner wall. The suborder has a vast diversity of species, often with very special environmental adaptations. There are six families: Minnows and carps, suckers, and four loach families.

Subfamily Minnow (Leuciscinae) is also difficult to distinguish and limit, even though its genera (or at least most of them) are truly closely related: natural, infertile hybrids have occurred. The genera can also be put into evolutionary order on the basis of anatomy. Some species reach sexual maturity at a L of 4-5 cm, while others do not become mature until they are one meter long. There are many elongated species as well as high-set ones (such as breams).

The European Roach (*Rutilus rutilus*) can be considered to be the representative member of the subfamily. L in central Europe is at most 30 cm, while some eastern European subspecies are as much as 50 cm long. The body is compact and medium high-set with a complete lateral line having 39-48 scales. There is one row of throat teeth. The pectoral fins are under or a little in front of the dorsal fin. The back is olive-brown to blue-green; the sides are matte gray-silver to yellowish-silver; the unpaired fins are yellow to bright red, and the eyes are reddish.

Roaches live in standing or slowly flowing waters in the Baltic Sea and in salty or brackish waters of the Black Sea-Caspian Sea basin. They are found among plants and spawn from April to May on year-old plants or plant remains. Schools inhabiting desalted parts of the sea migrate for spawning into fresh-water. One female lays up to 150,000 eggs. Roaches feed on algae and plant remains as well as small invertebrates including mussels. They have different commercial importance in different regions and are of value in the Baltic Sea basin, in the Sea

of Asov (where it is the subspecies Taran (*Rutilus rutilus heckeli*)) and in the Volga (the Vobla (*Rutilus rutilus caspicus*)). In these regions roaches are fished with nets and ring baskets. In central Europe they are often caught with hook-and-line using worms and flies as bait.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 54-56km, 65-69km, 208-209km

7. Dace (*Leuciscus leuciscus*)
Mongolian name: Sugas

The chief genus of the subfamily, the Minnow (*Leucicus*), is distributed through various subgenera in Eurasia and North America. They are medium-sized to large, elongated, with a slightly compressed body. The head is flattened and the dorsal and anal fins are rather short. The lateral line is complete. The two rows of throat teeth have hook-shaped points. Most species inhabit flowing waters.

The Dace (*Leuciscus leuciscus*) is in the subgenus *Leuciscus* and is small (L up to 30 cm). The mouth is partly on the lower side of the body; the anal fin is slightly indented, and the scales are small (45-55 in the lateral line). Its habits flowing water from trout zone to the mouths of rivers and also in brackish water and occasionally in lakes and ponds. Spawning is earlier in the year (March to April) and it is not a predatory species. Distribution is wide, including all of Siberia; the species is not found in most of southern Europe and in Turkey. It is not a commercially valuable fish but is caught with hook and line and is used bait.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 54-56km, 65-69km, 208-209km, 223km, 235km, 244-245km, 255km, 272km, 285km, 289km, Dund river (park, Ulaan-baatar)

8. Minnow (*Phoxinus phoxinus*)
Japanese name: Himehaya
Mongolian name: Varlan

The Minnow is small fish (L 9 cm, rarely 14 cm) with an elongated body, a small, terminal

mouth, short, rounded fins, two rows of throat teeth, very small scales, and an incomplete interrupted lateral line.

During the spawning season the sides of minnows take on an emerald-green hue; the corner of the mouth becomes carmine, the throat black, and the underside orange-red. This coloration disappears at once if the fish is frightened. Both sexes develop a distinct courtship coloration. Minnows inhabit mountain waters of streams, rivers and shore regions of the lakes, as well as ponds and pools. In northern Europe they descend as far as sea level. During the summer and early fall minnows are also found in the very warm river arms which have been transformed into pools. Clear, cool, flowing water, however, is required for spawning. Minnows almost always live in schools. The diet consists of plant matter, worms, crustaceans and insect larvae. The eggs are laid on gravel, stones or sand. In some areas minnows are eaten, for they have a good flavor; they are also very popular as bait for sport fishermen; and finally they are important prey of river trout.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, 208-209km, 223km, 235km, 244-245km, 255km, 272km, 285km, 289km, Dund river (park, Ulaan-baatar)

9. Common Gudgeon (*Gobio gobio*)
Japanese name: Tairiku sunamoguri
Mongolian name: Morin Guerts

The Gudgeon (Gogioninae) are small to medium-size carp with either elongate, low, or medium high-set bodies. The underside is flattened or rounded. The mouth is small and is terminal or on the lower body side. Many genera have a pair of upper lip barbs, but snout barbs are never present. There are either one or two row of throat teeth. Both dorsal and anal fins are short. the length of the intestinal tract varies considerably. Belly coloration is silvery or brown to black. The swim bladder is developed in most genera but is degenerate in highly specialized genera inhabiting flowing water; in these species the swim bladder is enclosed by a bony or fibrous capsule. Coloration varies considerably; there is a row of round or elongated lateral spots or a longitudinal stripe in many genera. Others have large, indistinct spots.

The Gudgeon genus *Gobio* is the only one prevalent in Europe. It contains thirteen species, five found in Europe. Four, including the Common Gudgeon (*Gobio gobio*), inhabit central Europe including the Danube basin. This fish is distributed from Ireland, England and the

Pyrenees to central China. It has a moderately elongate body with a laterally compressed tail shaft and eyes pointed outward. It is typically found in rivers, streams, and sometimes in ponds, lakes, and marshes, but spawns only in flowing waters. In western and central Europe it is being forced out of the central and lower Danube basin, where other species of the same genus occur, into the smaller loamy or muddy tributary streams. The species is a popular dish in France.

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 54-56km, 65-69km

10. Carp (*Cyprinus carpio*)
Japanese name: Koi
Mongolian name: Bueluu Tsagaan

The small Carp subfamily Cypriniane contains small and larger fishes with a high-set to very high-set body, a terminal or half-inferior mouth, and large scales. The dorsal fin is long, while the anal fin is short. The last unbranching ray of both fins is ossified and jagged. There are one or three rows of throat teeth. Barbs may be present or absent.

Carp inhabit standing or slowly flowing waters, spawning on plants and feeding on small invertebrates as well as flora. There are at most ten species, primarily in eastern Asia, with three found in Siberia and Europe.

The Carp genus *Cyprinus* is characterized by two barbs, and three rows of throat teeth which well-developed chewing surfaces. The single species is Carp (*Cyprinus carpio*); the body is relatively high-set; the back is gray-blackish or brownish and the sides are golden to rust-colored. The lower side is bright yellow and paired fins are slightly reddish during the spawning period. Coloration does vary somewhat; it is brighter in carps from rivers and darker in those species which inhabit muddy ponds. There are four other carp species placed in two poorly differentiated genera, which live only in China.

In many lakes and ponds carp are localized fish which spawn near shore and winter in the somewhat deeper parts of the same waters. River carp undertake migrations and spawn at sites with shallow and almost standing water. In the basins of large rivers with extensive flooded regions containing shallow lakes, carp are semi-migratory. Such basins are those of the Danube and the Volga. In spring the carp move out of the river into the flooded regions to spawn; when the water level drops the carp return to river beds. Carp in the brackish water of the Caspian and Asov Seas and in the low-salinity parts of the Black Sea migrate during the

spawning period into the rivers and their flooded regions.

Carp usually attain sexual maturity in four or five years, although fast-growing southern forms can mature in just three summers. Fertility is high: large females produce up to 1.5 million eggs. Egg-laying takes place at temperatures not below 12-13°C, but at best at 18-20°C. Eggs are laid on soft plants in shallow water. Carp spawn several times during the summer. In the southern range of distribution spawning usually begins early in May and ends in June, while in the north it occurs one month or more later. Egg development takes five days at a temperature of 15°C, but only three days at 20°C. The young feed on plankton and adults primarily choose invertebrate bottom-dwelling organisms, but occasionally flora. Within the main distribution, the primary diet varies: in the Amur basin it consists of midge larvae; in the Aral Sea it is ostracods and mollusks. Even within some limited areas, such as the lower Danube, there are many local variations in diet.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 54-56km, 65-69km

11. Goldfish (*Carassius auratus*)
Japanese name: Kin buna
Mongolian name: Bor Khelteg

The Carp (genus *Carassius*) differ from *Cyprinus* carp by the absence of barbs and the single row of greatly compressed throat teeth. There are two species: 1. Crucian carp (*Carassius carassius*) and 2. Goldfish (*Carassius aurassius*).

The Goldfish lives in eastern Asia from the Amur to eastern India. It is found in Japan but was probably introduced there. It differs from the crucian carp in the number of scales (26-31) and gill rakers (40-53), the brown to blackish peritoneum, the longer intestinal tract, the shape of the throat bone and the silvery coloration. Furthermore, Goldfish lack the black tail spot of the crucian carp. Goldfish are also not as high-set as crusian carp, but more closely resemble *Cysrinus* carp. Goldfish inhabit standing and slowly flowing waters.

As in all carp species, the otherwise docile male storms at female which is ready for spawning and can even injure it in the process. Males pursue females to and fro through the small garden ponds. During this time they are easy prey for birds and other enemies, because they forget all danger. The male unceasingly nudges the female to evoke egg-laying. Finally the

female sinks exhausted to the floor, but her male companions lift her by the snout until she is practically out of water. finally she releases eggs, 500-1000 of them, which are fertilized immediately by the males.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 54-56km, 65-69km, 208-209km, 223km, 235km, 244-245km, 255km, 272km, 285km, 289km

12. Stone Loach (*Noemacheilus barbatulus*)
Japanese name (general): dojou
Mongolian name: Sakhalt Jaraakhay

One carp family is the Loach (Cobitidae) family. These are small to medium-sized fishes. L is between a minimum of 30-60 mm and a maximum of 200-300 mm. The largest European member is the subspecies *Cobitis elongata bilseli*. The body is either short and compact or elongate and somewhat cylindrical; it can be quite slender in some species. The head is usually small, especially in the elongated species. The small eyes are completely covered by a layer of skin. The mouth is on the lower part of the head and is arched, surrounded by fleshy lips. In all species are actually greatly developed chin flaps of the lower lip. The location of the barbs differs; cobitin loaches have a pair of snout barbs and two upper lip barbs. The chin flaps in some genera (e.g., *Misgurnus*, *Lepidocephalus*) are well developed; the only cobitid without barbs is *Neoeucirrichthys maydelli*. In Niwaella the barbs are very short while the lips are well developed, forming a kind of sucking disc. The number of loach species can only be estimated since a few which have been regarded as species are actually only subspecies. There are three subfamilies: 1. Botiins (Botiinae); 2. Noemacheilin loaches (Noemacheilinae); and 3. Cobitin loaches (Cobitinae).

The noemacheilin subfamily differs from both others particularly in the absence of a spine beneath the eye. The body is generally elongate and is more or less cylindrical; the body is short and compact in only a few species. The head is usually flattened. There are two pairs of snout barbs and a pair of upper lip barbs. Chin folds are never present. The dorsal fin in most species is short (with 7-10, rarely more, entwined fin rays), except in *Vaillantella*. The body either lacks scales or has a partial or complete covering. The caudal fin may be rounded, clipped, or indented, but never to the extent of the botiins. Many species have a well-developed adipose process on the upper edge of the tail shaft. With about 120 species, this is the largest loach subfamily. Most are in the genus *Noemacheilus*; there are also two to four

small genera.

Most of these loaches inhabit fast-flowing rivers and streams. A few, especially those in mountainous Asia, have adapted to living in ponds and lakes. In these species the swim bladder (unlike that of most loaches) is developed and had two or three chambers. The rheophilic ("current-loving") species prefer pure, oxygen-rich water and sandy or gravel bottoms. They feed mostly on insect larvae and other bottom-dwelling small organisms or algae. The genus *Vaillantella* is completely divergent; its members have a very long dorsal fin and about sixty entwined fin rays.

The major genus *Noemacheilus* will probably be subdivided into several genera in the future. It includes the Stone Loach (*Noemacheilus barbatulus*, maximum L 16 cm). This elongated loach dwells on the firm bottom of flowing, clear waters. It is also found in regions where trout, grayling and chondrostomes live. Its diet consists of insect larvae and crustaceans. The spawning period is in spring (March and April).

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 54-56km, 65-69km, 208-209km, 223km, 235km, 244-245km, 255km, 272km, 285km, 289km, Dund river (park, Ulaan-baatar)

13. European Cobitin (*Cobitis taenia*)
Mongolian name: Tchimkhueuer Zagas

The cobitin subfamily (Cobitinae) is characterized by an elongated, more or less laterally compressed body, with one pair of snout barbs and two pairs of upper-lip barbs, a front and a rear barb (on the edge of the mouth). Chin folds are always present, and are sometimes quite well developed. The spine below the eye is short and its two branches are horizontal. There are almost always small cycloid scales, which in some species are also on the sides of the head. The lateral line is usually incomplete, extending at most to the middle of the body. There are fourteen genera and about fifty species distributed throughout most of Eurasia as well as Japan, Borneo, Java, Ceylon and Morocco.

Most cobitins inhabit flowing and very rapidly flowing waters; some live in lakes and ponds (such as the pond loaches and species which dig into sand or mud; the best example of the mud-digger is *Cobitophis*). The life habits of many Asian species are unknown. Cobitins do have special adaptations, for example a very elongated, spindleshaped body, as in

Acanthophthalmus and *Cobitophis*, as well as doubled upper lips and the lack of barbs in *Neoeucirrichthys maydelli*.

The European Cobitin *Cobitis taenia* is small, with a L of to 12 cm (males do not exceed 9 cm). The body and especially the head are compressed laterally, and the spine beneath the eye is well developed. There are several subspecies, of which a few are now considered to be distinct species. The fish lives in flowing and standing water but prefers clear water with hard or sandy bottoms. It feeds nocturnally on invertebrates. In spring and summer its spawns on the river bottoms.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 208-209km, 223km, 235km, 244-245km, 255km, 272km, 285km, 289km, Dund river (park, Ulaan-baatar)

14. Catfish (*Silurus asotus*)
Japanese name (general): Namazu
Mongolian name: Khar Moerniy

The Catfishes (order Siluriformes) are generally bottom-dwelling fishes with barbs on the head. There are no scales; the body is either naked or covered with bony plates arranged in rows or forming an armored covering. The upper jaw has typically degenerated and functions as a point of attachment for the barbs. Sometimes the barbs have supportive cartilage; others have a support mechanism which permits barbs to relax as soon as the fish dies. The barbs contain taste organs and thus in a sense are an extension of the tongue. This is logical since the majority of catfishes are active at dusk and at night and need a supplementary organ to detect food. The number of catfish families varies according to different authorities.

The Eurasian Catfishes (Siluridae) have given the entire order its scientific name. The various species differ considerably in body size. The European sheat-fish may be several m long like some southeast Asian species. However, there are also dwarfs among the European catfishes which are just a few cm long. The slin is always naked; there are two or three barb pairs which can be quite long. With a few exceptions there are bottom-dwelling species which spend most of the day lying on the floor or concealed in recesses. The pure free-swimming varieties live in schools and small swarms and are active by day.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 208-209km, 223km, 235km, 244-245km, 255km

15. Burbot (*Lota lota*)
Japanese name: Katamintai
Mongolian name: Gutaar

The members of the following fish order live almost exclusively in salt water. The order includes the well-known common codfish which gives the order its name, Codfishes (Gadiformes).

The more primitive cod species are characterized by a uniform unpaired fin seam which, as in eels, combines the dorsal, caudal, and anal fins. In higher cod species the caudal fin is clearly distinct, but the long fin seam is still maintained by a long uniform dorsal fin and anal fin. Some groups have other structural peculiarities of the fin seam: the dorsal or anal fins may have indentations or even be split into at most three dorsal and two anal fins. The position of the paired fins is also an important characteristic: pelvic fins are usually present but in some species are not situated in the normal position. They are always well to the front and are almost always clearly in front of the pectoral fins. Codfishes are also called soft-finned fishes because as a rule their fins are composed entirely of soft rays. A hardened or spiny ray in the first dorsal fin is found only in the grenadier fish. The swim bladder lacks an air duct (the ductus pneumaticus) to the intestinal tract. There are five suborders: 1. Eel cods; 2. Codfishes; 3. Cusk eels; 4. Viviparous blennies; and 5. Grenadiers; there are ten families with at least 150 genera and over 200 species.

The codfish family (Gadidae) has at least twenty-two genera with over twice that many species. The life habits vary considerably. A great diversity of forms developed as a result of adapting to different environmental conditions. Codfish habitat is generally limited to the shelf regions off the coasts. A few species also inhabit the shelf itself as far down as 1000 m, but they avoid great oceanic depths.

Practically identical external and internal features between Burbot (*Lota*) and Ling (*Molva*) point to their close relationship. Both species have very elongate, almost eel-shaped bodies. The arrangement and division of the unpaired fins is the same as in forkbeards. The only difference is that the first dorsal fin of both the Burbot and the Ling is rounded and does not have as greatly elongated a fin ray. However, in spite different habitats. Burbot is the sole

fresh-water codfish species, while Ling cod are found only in oceans.

Burbot (*Lota lota*), with a L of up to 1 m and a weight of 25 kg, is distributed around the North Pole and is found in rivers and lakes of central and northern Europe, northern Asia and North America. Three subspecies are distinguished within this distribution: *Lota lota lota* in middle and northern Europe and Northern Asia, *Lota lota leptura* in eastern Siberia, Alaska and northwestern Canada, and the Alekey Trout or Eel-pout (*Lpta lota maculosa*) in the rest of Canada and down to its southern distribution border in the U.S.A.

Burbot prefer clear water and coarse or rocky ground which offers sites for concealment. While the body has a predominant brownish, marbled pattern, there are many local variations. In the mouths of rivers they rarely penetrate as far as brackish water. Unlike many other fishes, Burbot are most active in winter, spending the summer burrowed in the ground. While the young feed mainly on small crustaceans and insect larvae, the chief diet of adults is fishes and fish eggs. Burbot reach sexual maturity in three to four years. Large, older females can lay over 3 million eggs in one spawning season. They spawn in the late winter months, chiefly in sites in the upper courses of rivers. The 1 mm-large eggs lie on the floor or float just above the bottom. Burbot are of commercial importance only locally, particularly along Siberian rivers such as Ob.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 208-209km, 223km, 235km, 244-245km, 255km, 272km, 285km, 289km

16. River Perch (*Perca fluviatilis*)
Mongolian name: Algana

Within the Spiny-rayed fishes superorder (Actinopterygii) the Perch-like Fishes (Perciformes) form the order with the largest number of species and greatest variety of any present-day fish order. The order is presently divided into twenty suborders with over 150 families it is difficult to summarize the common characteristics of this group briefly.

The Perches (suborder Percoidei) contain more than ninety families, thus forming the largest group within the perch-like fishes. Most perch species are found in tropical and subtropical waters.

Perches (Percidae) are fresh-water fishes found in the northern hemisphere; a few also occur in brackish water for short periods of time. Of the approximately 120 species, only twelve are found in the Old World; all the rest are in North America. The body is more or less elongated, either somewhat compressed laterally or cylindrical, with ctenoid scales. The head is naked or partially covered with scales. There are generally two dorsal fins, although there are a few species in which the dorsal fins are fused. The front part of the first dorsal fin has powerful rays which are much longer than the rays of the soft part of the fin. The anal fin has two front spiny rays, sometimes just one. The diet consists of fishes, fish eggs, worms, crustaceans, insect larvae, and other invertebrates.

The best-known species is the Perch (*Perca fluviatilis*, L about 30 cm, occasionally 45 cm, weight up to 2.5 kg). The perch occurs in most standing or flowing waters in Europe, with the exception of the northernmost and southernmost parts of Europe; perch are also found in Asia Minor and northern part of Asia. In old perch, the high back process behind the head is a very characteristic feature. The greenish tones of the body are interrupted by six to nine dark diagonal stripes and a black spot at the end of the first dorsal fin. The pelvic fins and anal fin are often a brilliant orange-red, or yellowish in perch from inland lakes. However, this kind of fin coloration is not found in all species. Generally, three local color forms are distinguished: a bright green variety found between plants along the shore; a lighter, pale yellow form found in open water; and a darker perch found at depths down to 50 m.

During the spawning season in March to June, males are more brilliantly colored than females. The eggs are laid in shallow water near the shore in the form of long gelatinous ribbons; they are laid on aquatic plants, rocks, or other objects with no preference, and are fertilized by one or more males. The ribbons can be up to 1 m long, and are about 2 cm wide. Naturally the number of eggs laid depends on the size of the female; at most one female lays 300,000 eggs. Since the parents desert the eggs, many of them do not survive. Yet in spite of that several thousand larvae will hatch after eight to sixteen days, depending on the temperature of the water. The juveniles form large schools and initially feed on zooplankton, which must soon be supplemented by other food, since the young grow very quickly. In the fall the young perch are already 6 to 8 cm long, and by the second summer they are 9-13 cm long. They attain sexual maturity no sooner than the end of the second year, when they are 14-17 cm long. Perch are commercially important only where larger ones can be caught frequently, such as in Lake Constance, Lake Laacher, along the coast of the Baltic Sea, and in lagoons. The white, firm meat is quite tasty, especially from Baltic Sea Perch.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 208-209km, 223km, 235km, 244-245km, 255km, 272km, 285km, 289km

17. Siberian sculpin (*Cottus sibiricus*)
Mongolian name: Antaakhay Zagas

The Scorpionfish order (Scorpaeniformes) is a very large, diverse group of fishes, but all members have a number of external characteristics in common. This is best exemplified by the bony element underneath the eye, which has given the order its English common name Mail-cheeked Fishes. The fishes are small to medium-sized species which are found in all seas of the world; some also inhabit fresh water. They are perch-like in appearance, with a large head which is partially of fully covered by a bony armor. This bony covering may also have spines. There are usually several spines on the rear edge of the front gill cover. The gill covers have two bony processes which terminate in spines. The dorsal fins are usually united, but in seven families they are distinct. The pectoral fins often have a very broad base. One or more rays can be free from the fin skin. The pelvic fins are at the same height on the body ridges on the head are important identifying features. There is one ridge above the eye and one ridge below it on the bony plate; the ridges vary in length.

Scorpionfishes belong to the advanced spiny-rayed fishes, and as such they lack a proper swim bladder. The swim bladder is sometimes poorly developed or absent altogether, and when present it often serves the function of producing sound. Generally scorpionfishes live near the coast, while a few occur in deep to very deep water. Many have strikingly beautiful coloration or remarkable camouflage patterns. Some species have poison glands associated with the fin spines, the glands being located at the base of the fins. This order contains the world's most poisonous fishes; their poison is, however, used solely for defense. The poisons produced are neurotoxins (i.e., they affect the nervous system), but they have a hemotoxic effect as well (i.e., acting on the blood). For this reason all scorpionfishes should be handled with care. Generally they move with undulating motions, and most are very quiet. The meat of all scorpionfishes is edible and is often very tender and tasty; thus some species have high commercial value. Six suborders with twenty-one families are distinguished.

In European fresh waters the chief representative of this family is the Bullhead or Sculpin (*Cottus gobio;* L 10-18 cm); the species is also found in western Asia and Siberia, and penetrates brackish water such as along the inlets of the Baltic Sea. Since the bullhead prefers pure, cool water, it is found in the trout zone even beyond an altitude of 2000 m. During the day it remains concealed, and at the onset of dusk begins feeding; the prey consists of insect

larvae, amphipods, small fishes, and fish eggs. Bullheads are very unpopular with fishermen since they feed on trout eggs and trout broods; but trout also feed on bullheads. Sculpins are found primarily on the sandy and stony ground of cool streams in the trout zone and on the banks of large lakes; however they are also encountered in large, deeper, flowing bodies of water if these are cool enough.

The spawning season occurs between February and May. Before the eggs are released, a courtship display takes place, in which the already intense colors of the males become even darker. After a short display the female lays the eggs on the lower side of a rock, where the male fertilizes them and guards them during the developmental period, which lasts up to five weeks. Sculpins are easily kept in aquaria, particularly when they are supplied with clear, clean water which is not too warm and which has sufficient oxygen. They have little commercial importance, but are often used as bait.

A close relative, *Cottus poecilopus* (L8-12.5 cm), inhabits the northern German lowlands, and its life is much like the sculpin previously mentioned. This species also inhabits northern Europe, all of northern Asia, and the Carpathian mountains.

Prohibited fishing from April 1st to June 15th

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km

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Appendix 17-7(b) Amphibians around the Project Sites

1. Common Toad (*Bufo bufo*)
Japanese name (general): Hikigaeru
Mongolian name: Bor Bakh

In family True toads (Bufonidae), there are no teeth in the jaws; males have the Bidder's Organ. Some have a reduced number of vertebrae, presumably because the sacral vertebrae have been incorporated into the coccyx. With about 250 species, the genus *Bufo* is the largest one in the family; it is distributed throughout the world, being absent only from Greenland, Australia, New Guinea, New Zealand, and Malagasy.

The most familiar European true toad species is the European (Common) toad (*Bufo bufo*), with a flat, thickset body, horizontal pupils, and a warty skin. Males are smaller and more slender than females, and from fall to spring the males have dark nuptial pads on the three inner fingers. Coloration varies considerably; in the same individual it can vary from light yellow to black depending on the mood, humidity, season, and molting activity. A parotid gland lies behind each of the eyes; it secretes a white poisonous fluid. This fluid irritates the mucus lining of the eyes, nose, and mouth, and it has a powerful toxic effect if it is injected into the bloodstream.

In lowlands, toads leave their forest hiding places in the second half of May. Without feeding, they make their way to their spawning sites, which are found in standing, permanent waters, and which are used every year by the same toads. After the onset of dusk, hundreds and even thousands of toads wander toward these spawning sites (if the temperature is not below 5℃). Rainy weather results in much more movement than dry nights do. This journey can extend up to 1 km. They begin mating during the journey. There are about seven males for each female. The males jump on top of every object which is about the size of a female, including other males. If a male is mounted, he utters a characteristic cry, a series of calls lasting 80-100 milliseconds each, accompanied by lateral movements which make it seem as if the toad is coughing. This reaction can be released in every male toad in the spring simply by holding the toad under its armpits with two fingers. Females only make the coughing movements without vocalizations if they are not prepared to spawn. These calls and gestures indicate to the male that he has chosen an inappropriate object for mating, and he will climb off the erroneously chosen partner. If an appropriate female is encountered, she will hold still until the male embraces her under her arms; then she moves off to the spawning site with the male on her back.

Once the toads have reached their spawning site, they spend several days in the reeds and on the floor of the pond in deeper water. Spawning occurs under the influences of the water and the amount of day-light; which stimulate the female to ovulate (i.e., release eggs from the ovaries. Meanwhile, all the females have been joined to males. It is all based on trial and error, not the mating calls found in frogs and most other toads. The Common toad male has a vestigial vocal sac, and while it does indeed have a mating call, the call is very soft and it is very rarely used.

As soon as the eggs are released from the ovaries, six to fourteen days after the pair has reached the water, the pair becomes restless and seeks out reeds, branches hanging into the water, or other suitable plant objects. The female anchors herself there, extends both hind legs paralleled to the rear, and forms the signal position. While she is in this position, the eggs are released in the form of two long fibers. They are fertilized immediately by the male, since the signal position of the female stimulates the male to release sperm. The male fertilizes egg fibers about twenty centimeters long each time the female assumes this stereotyped position. In the Common toad, the entire egg fiber is about 2 m long, so spawning has to be repeated ten to twenty times before it is concluded. The entire process lasts five to ten hours, and occasionally more than twenty-four hours. The male does not assist in stimulating egg laying; the female will release the eggs whether the male is there or not.

During pauses in spawning, when the pair breathes air, the egg fibers are pulled about as long as they can be, and are wrapped around plants. Once the male perceives that no more eggs are being released, he climbs off the female. The female leaves the spawning site the following night and moves toward the summer grounds. Males remain around the site for a few days.

The return to the summer grounds occurs with the same accuracy and apparent purposefulness as movement toward the spawning sites. Toads often seek out the very same spot which they had defended the previous summer as their hunting territory. Usually the summer grounds are 500-1500 m from the spawning area, but some toads move up to 3km away; on the average, females travel further from the spawning sites than males. As soon as they have reached the summer grounds, in the second half of April, they return to the inactivity which characterizes their behavior during winter as well. They do not go out hunting at night until the temperature is 11-12 ℃ and it is raining.

The toads do not come out again until May. Now the young and the females which were not at the spawning sites become active; most females do not spawn two seasons in succession. The toads have not eaten anything since the fall of the previous year; but during the summer they utilize hunting territories during rainy nights. These territories have a diameter of 50-150

m. The toads eat ants, earthworms, nocturnal snails, spiders, flies, and bugs. Most toads spend the summer in forests; some occupy human habitations.

The nuptial pads of the male disappear until the longest day of the year; after spawning, the skin of these pads is cast off. However, the pads begin to get darker just two weeks later; August they are brown, and when wintering begins in October they are almost as dark as they are during the spawning season. This hormonal change, reflected in the cyclic development of the nuptial pads, can be seen in other ways as well: from the middle of August and into September the toads are stimulated to migrate, and they leave their summer grounds. During this fall migration, which extends anywhere from just a few hundred meters up to 2 km the toads approach their spawning sites several times. At the end of September and into October they dig into suitable places in forests, and will not come out of these hiding places again until their reproductive drive is awakened in spring; the new spawning migration closes their annual cycle.

This annual cycle occurs for toads in the plains and at moderate altitudes, as long as they have a permanent pond which can be used for spawning. In the mountains and in the north the spawning period begins somewhat later, and they dig in for winter at an earlier time in the fall. Toads which reproduce in pools of water that change from year to year (i.e., in small river inlets, gravel pits and other non-natural spawning sites) are forced to keep changing their spawning sites. In these cases the spawning season is more extended; males call more frequently.

On the average, the Common toad has a greater life expectancy than other anurans. Males attain sexual maturity after three to five years, while in females it takes four to six years. Adult males, which are at least three or four years old, have the following live expectancy: 80% of them will live an additional year; 45% live two more years; 21% percent live three years more, and 6 percent will live four more years. A few individual toads in nature live up to ten or eleven years and in captivity they live to be still older.

The larvae, which hatch in April, metamorphose during the second half of July of the same year. The Common toad tadpoles have an interesting social behavioral pattern: they look like pitch-black nails, and often line the shore in great masses. To get to a new feeding site, they form a continuous group with a broad front, or they move through the water in a band-shaped procession. That this is truly social behavior is indicated if one of the tadpoles becomes injured; all other tadpole dart about to all sides and below the place where the tadpole was hurt. When a tadpole is injured, it secretes a substance from the back which frightens the other tadpoles and serves as a means of warning them. The adults and tadpoles also produce poison

which protects them against many potential enemies, such as *Rana temporaria* tadpoles. Other potential enemies which avoid them include perch, minnows, and salamanders.

Sites: 54-56km, 65-69km, 92-96km, 110km, 170km, 208-209km, 315km, 335km, 358km, 399km, Tuul river and Dunt river

2. Moor Frog (*Rana arvalis*)
Japanese name (general): Kaeru
Mongolian name: Shevgier Melkhiy

True frog or ranid family (Ranidae) distributes worldwide, and is divide into approximately ten subfamilies, depending different author. Since seven of these occur in Africa, it is felt that the true frogs originated on Africa.

The true frog subfamily (Raniae), particularly genus *Rana*, are the most familiar frogs. *Rana* is Latin for frog. Systematically, the true frogs are distinguished from their relatives by an ossified sternum and tapering fingers lacking discs or pads. True frogs are distributed on every large land mass on the earth except Greenland; they are also absent from New Zealand, central and southern Australia, and southernmost South America.

**Rana temporaria* spawns on the plains in February and March and in the Alps in June. The spawning season is much shorter in this species than in others; in a period of one to three nights, large groups of the frogs lay hundreds of egg masses in a small area so that the eggs are packed quite densely. This gives rise to an interesting question. Outside the breeding season, *R. temporaria* are found in forests and damp meadows several hundred meters from the spawning sites. The species can only utter a very soft, rumbling sound something like the purring of a cat.

In natural surroundings, the frogs have a highly developed tendency to return to the same waters which have been used to spawn for generations. When each individual frog reaches sexual maturity (i.e., after three years) it returns to the water in which it had metamorphosed, and spawns there. The frog retains a sense of recognition for the qualities of its home waters.

R. temporaria tadpoles are the first amphibian larvae to conquer the ponds in spring. The others do not spawn until the second half of April. This temporal advantage is used by *R. temporaria* to maintain the chief position in the ponds. they feed o the freshly laid eggs of the

other species, which means that these other frogs have little chance to survive in waters which have scarcely any other food sources for *R. temporaria.* In June, the two-to-three-month-old larvae metamorphose and, if the season is good, leave their ponds simultaneously in such numbers that one speaks colloquially of frog rains. They lead a solitary nocturnal life in meadows and forests, like their parents, and attain sexual maturity in three years.

Once a frog is sexually mature, it has much better chances for survival than those of a mammal or bird which are equally large. Of all the *R. temporaria* frogs which are three years old, 43 % will live one more year; 32 % will live two additional years; and 14 % will live to be six years old, at which time their young will be reproducing. However, a population can disappear entirely in a much shorter time if, in addition to natural predation, it is subjected to any number of accidents and human interference such as excessive freezing of water due to a low water level, road kills, poisoning, death by harvesting equipment, falling into irrigation canals, destruction of the eggs by upheaval of the spawning sites, or other drastic changes. Even "harmless" moss-killing herbicides can prove fatal to the frogs.

The Moor frog (*Rana arvalis*) is smaller, has a more tapered head, and is more delicate than *R. temporaria.* It usually has a light longitudinal band along the middle of the back.

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 208-209km, 223km, 235km, 244-245km, 255km, 272km, 285km, 289km, Dunt river (park, Ulaan-baatar), 420-421km

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Appendix 17-7(c) Birds around the Project Sites

1. Grey Heron (*Ardea cinerea*)
Japanese name: Ao sagi
Mongolian name: Khuekh Degliy

Field mark: 91 cm. Gray; crest, wing edges, and stripe on neck black; belly white. Legs yellowish-brown; bill brown.

Habits: Grey heron inhabits bodies of water in various landscapes, from taiga to desert. It is migratory, in places nonmigratory. It nests in pairs or colonies on river banks, lakes, and reservoirs. Its nest is loosely cone-shaped, made of branches and reed stalks, and built on high trees, in flooded osiers, or stands of reed. It nests from April (in the south) and later. Grey heron lays four or five light-colored, greenish-blue eggs. It is cautious. Its flight is smooth with slow wing beats, strong and even; takeoff is clumsy, with legs dangling. Its head is drawn into shoulders in flight. It is usually silent.

Call: short, rasping, piercing, unpleasant cry, resembling "krryank", usually uttered in flight.

Grey heron feeds by wandering through water on shoals, river spits, and sometimes in marshy meadows. It often stays motionless on the bank, with neck drawn in, and feeds on small fish, insects, frogs, and other small animals.

Sites: 17pk9-19pk2, 65-69km, 285km, 442-443km

2. Greylag Goose (*Answer answer*)
Japanese name: Haiiro gan
Mongolian name: Bor Galuu

Field mark: 70-82 cm. Size of a domestic goose, which is derived from this species. Light gray, especially back and rump; black spots on belly (which juveniles lack), undertail white; bill and legs pink.

Habits: Greylag goose is found in fresh-water areas in variety of habitat from taiga to desert, and is migratory and common in places. It nests in pairs in lakes overgrown with reeds, in flood plains and estuaries, marshy grass swamps, and chooses remote, nearly inaccessible areas for nest. Its nest is made of reed stalks or other plants, and lined with down and is

situated in dry place (hillock, islet, hummock), on dry, fallen reed, or floating mat of sticks and leaves. Greylag goose lays four to six white, sometimes yellowish eggs beginning in April (in the south) to June. Hatched goslings and parents stay together in flocks before migration. Greylag goose is very cautious, especially in flocks; except during breeding and hatching, when it allows close approach. When molting, it loses ability to fly, and usually feeds in the morning and in the evening in meadows and fields; it is often far from bodies of water; it spends the night and middle of the day on open water. Its flight is fast, although it appears unhurried. During migration its flight pattern is high, forming an angle; when flying to feeding ground, flock forms an irregular line. Its call is similar to domestic geese. It feeds on various herbs and grasses, and pecks at new sprouts, seeds, and tubers. The Greylag Goose is the ancestor of a majority of domestic geese.

Prohibited Hunting Seasons: from May 1st to September 1 and from October 21st to April 1st of the following calendar year.

Sites: 54-56km, 65-69km, 272km, 285km, 335km, 420-421km

3. Ruddy Shelduck (*Tadorna ferruginea*)
Japanese name: Tsukushi gamo
Mongolian name: Angir

Field marks: 62 cm. Rusty-orangeish; head ocherich-white; narrow black band around neck; white patch on wings, black primaries. Female is smaller than male; head yellowish, no neckband.

Habits: Ruddy shelduck is found in salt-water or fresh-water lakes, rivers of steppe and desert, bodies of water in mountains. When migration it stays on large salt lakes. It is migratory and common. It nests in pairs near open bodies of water with hard-soil banks and sparse vegetation and in deep burrow, which the bird digs; or, more often, it uses abandoned or even inhabited burrows of foxes, badgers, or marmots; or nests in deserted structures, broken tombstones, gaps or niches in precipices. It lays eight to twelve cream-colored eggs from early April on. Nest lining is white down with a few rusty feathers. It stays in pairs; when breeding, male stays near the nest. Its flight is fast but heavy, with strong, infrequent wing beats. Ruddy shelduck walks on ground easily, and often perches on rocks.
Call: clear, guttural, and sad "aang-aang". When sitting on nest, female hisses if danger approaches. It feeds on water, and seldom dives.

Prohibited Hunting Seasons: from May 1st to September 1 and from October 21st to April 1st of the following calendar year.

Sites: 17pk9-19pk2, 54-56km, 65-69km, 289km, 335km, 420-421km, 429-430km, 434-435km, 442-443km, 464km

4. Mallard (*Anas platyrhynchos*)
Japanese name: Ma gamo
Mongolian name: Zerleg Nugas

Field marks: 49-57 cm. Size of domestic duck, which is, in turn derived from this species. In male, its head is dark green; upper breast chestnut; rump and undertail coverts black; bill yellow; legs orange. Female brown with dark mottling; dark blue speculum; bill orangeish with dark center. In summer, plumage of male resembles female, but bill yellow-green.

Habits: Mallard is found in bodies of fresh water in a variety of habitats from forest-tundra to deserts and mountains. It is migratory, common and numerous. It nests near lakes with overgrowth, wet grassy swamps and meadows. Its nest situated in dense grass, bushes, or under fallen deadwood, usually not far from water. Sometimes it uses abandoned nests of herons or crows in trees. It lays seven to twelve white eggs with greenish or olive tint in early April (in the south) and later. Its nest is lined with dark down. During hatching, female allows close approach before flushing out from it under foot. When eggs hatch, female engages in distraction display to lead the intruder away from the nest. From the end of May, drakes gather in small flocks and fly to molting areas. Some drakes molt near breeding site. Juveniles take wing by August. Migration lasts until first frosts. Call resembles quack of the domestic duck. It feeds in water, excellent diver; its flight is fast and decisive. It feeds on small invertebrates (insects and their larvae, small crustacean, mollusks) and water plants.

Prohibited Hunting Seasons: from May 1st to September 1 and from October 21st to April 1st of the following calendar year.

Sites: 54-56km, 65-69km, 272km, 285km, 335km, 429-430km, 442-443km

5. Gadwall (*Anas strepera*)
Japanese name: Ooyoshi gamo
Mongolian name: Bor Nugas

Field marks: 50 cm. It is smaller than Mallard; gray; brownish head with fine black markings; scaly pattern on upper breast and flanks; wings with chestnut-brown over white speculum; undertail coverts black. Female brown with dark mottling on back and breast; in flight, wings similar to male; bill and legs yellowish.

Habits: Gadwall is found in fresh water; more rarely bodies of salt water in forest-steppe, steppe, and deserts; occasionally in forests. It is migratory and common in places, but does not form large flocks. It nests in small lakes, oxbow lakes, channels, estuaries; or any area with lush water vegetation. It builds nest on dry site, often far from water; in the steppe, under a bush or in the open. It lays seven to eleven white, slightly yellowish or olive eggs from mid-May. Female on nest allows close approach. When molting, males hide in remote areas of lakes. Its flight is light and fast, rather noisy; the bird flushes from water almost vertically. In flight, the flock communicates often by quacking. Gadwall swims with slightly raised hind quarters; rarely dives. Call of male: deep sonorous cry, resembling call of raven; of female: shrill quack. It feeds mostly on vegetation (terrestrial and aquatic); in shoals, often in steppe.

Prohibited Hunting Seasons: from May 1st to September 1 and from October 21st to April 1st of the following calendar year.

Sites: 17pk9-19pk2, 272km, 285km, 289km, 335km, 420-421km

6. Golden Eagle (*Aquila chrysaetos*)
Japanese name: Inu washi
Mongolian name: Tsarmuin Buerged

Field marks: 82 cm. Large eagle with broad wings and long tail. Black-brown; underparts lighter; pointed golden-yellowish feathers on nape and back of neck. Juveniles: tail white with wide, dark band on outer tail; in old birds base of tail obscurely whitish, but without contrasting dark band. Claws very strong, large.

Habits: Golden eagle is found in mountains, forests, and deserts. It settles in areas where cliffs or tall forests alternate with open spaces; in taiga, it prefers river valleys; in mountains and deserts it is found everywhere. It is nonmigratory or nomadic. It is rare, but more common only in Yakutia and in mountains of Central Asia. It builds massive nests with thick boughs on inaccessible rocks or high trees; in desert, on ruins, or saxal trees. It lays one or two white eggs, usually (not always) mottled a bright reddish-brown in March or April. It is very wary.

Call: gruff and hoarse "kiek-kiek-kiek". It feeds on different animals (hares, foxes, marmots) and birds; often carrion. In Kazakhstan and Central Asia, it is used for falconry. It is included in the Red Data Book.

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Sites: 272km, 420-421km, 465km

7. Black Kite (*Milvus migrans*)
Japanese: Tobi
Mongolian name: Sokhor Elee

Field marks: 57 cm. Dark brown; underparts lighter with rusty tones and dark brown mottling; crown notably lighter than back; forked tail hardly visible. Juveniles have large ocherish tips to body feathers.

Habits: Black kite is found in a variety of habitats except northern taiga and tundra, and inhabits forests of various types; often river valleys, areas near lakes or other water bodies; often found near settlements and cities. It is migratory, and one of the most common and frequently seen raptors. It nests in trees, more rarely in precipice niches. Its nest is lined with rags, wool, scraps of paper, and other rubbish. It lays two or three white eggs with brown or violet spots end of April to May. Often it forms nomadic flocks and nesting colonies. Call: long, tremulous trill, resembling neigh of a foal in the distance. It searches out prey by soaring at a great altitude for a long time. It feeds on carrion, dead fish, various wastes in dumps and slaughterhouses; more rarely on frogs, lizards, small birds, and rodents.

CITES Appendices II

Sites: 10pk8-10pk6, 17pk9-19pk2, 65-69km, 92-96km, 255km, 272km, 285km, 289km

8. Northern Goshawk (*Accipiter gentilis*)
Japanese name: Ootaka
Mongolian name: Uleg Khartsgay

Field marks: 48-58 cm. Large accipiter (larger than a crow). Upperparts dove-gray or brownish-gray; head slightly darker, with white eye stripe; underparts light with dark narrow

barring; undertail coverts fluffy white. In the extreme northeast of the USSR, nearly white specimens are occasionally found. Eyes and legs yellow. Juveniles, brownish with elongated spots on breast and belly.

Habits: Northern goshawk is found in forest, forest-steppe, and forest-tundra. It prefers coniferous and deciduous forest, where it stays in various areas but avoids dense woods. It is nonmigratory and nomadic. It is common, but very cautious and not often seen. It nests in trees (pines, spruces, birches, oaks, lindens), often using nests of other birds. Lays three or four white eggs in April. Call: ringing "kyak-kyak-kyak" or "gig-gig-gig". It catches unsuspecting prey by suddenly flying out of ambush. Short wings and long tail permit the bird to change direction readily, and to slow down or accelerate flight sharply while pursuing prey among trees. It feeds on different birds (pigeons, woodpeckers, hazel-grouse, black grouses, partridges, and others); also mammals (hares, squirrels).

CITES Appendices II

Sites: 92-96km

9. Common Buzzard (*Buteo buteo*)
Japanese name: Nosuri
Mongolian name: Sar

Field marks: 53 cm. Coloration varies greatly: upperparts usually dark brown; underparts lighter with elongated mottling. Tail banded often with wide, dark band at tip. Occasionally some birds very light with whitish underparts and pale mottling. Legs yellow.

Habits: Common buzzard is found in forest and forest-steppe; in places where wooded areas alternate with open areas (meadows, swamps, wood-cutting areas, forest edges). It is migratory, and one of the most numerous and often-seen raptors in the central belt of the USSR. Its nest is made of boughs situated in trees. It lays two to four white eggs spotted with rust in April and May. It is unwary near the nest. Noisy; call: mournful, nasal, long "kiii-kiii". It hunts prey from air and soars for long periods with motionless wings; it sometimes pauses in flight; it frequently hovers like the kestrel. It feeds on small rodents, frogs, insects; rarely on birds.

Sites: 235km, 255km, 272km, 420-421km, 429-430km, 434-435km, 442-443km, 465km

10. Common Crane (*Grus grus*)
Japanese name: Kuro zuru
Mongolian name: Kharkhiraa Togoruu

Field marks: 103-120 cm. Large crane with an overall gray coloration, with blackish wing tips. Head and neck black; broad white stripe from cheek down neck; crown is bare and covered with red wartlike skin. Legs black. Head of immature is feathered, and lacks red color.

Habits: Common crane is found in a variety of habitats from forest-tundra to desert and mountains; found in open or wooded, swampy places. Migratory. It is not numerous, but more common than other cranes. It remains paired throughout year; young stay with parents (in flocks) until following spring. Nest is a flat mound of grass, frequently situated in shallow water or on a reed mat, sometimes in a thicket; its nest is used several years in a row. It lays two brownish or greenish-olive eggs with red-brownish spots from April to June, depending on location. It is very wary; if threatened it will usually leave the nest quietly, and not fly until some distance away; it will, however, occasionally allow close approach. During breeding season, several birds will gather together and take turns performing characteristic displays, consisting of squatting, hopping, and calling, with half-open wings. Its flight is straight, with even, deep wing beats, and neck and legs outstretched. During migration, birds fly in V-shaped formation. Call: loud, trumpeting, shrill cry, sometimes a low muted trill. It feeds in dry places, preferring various seeds (including wheat and peas), berries, young shoots; frequently eats insects, mollusks, occasionally small vertebrates (frogs, rodents). It is protected everywhere.

Sites: 255km, 272km, 285km, 289km, 335km, 420-421km, 429-430km, 434km-435km, 465km

11. Herring Gull (*Larus argentatus*)
Japanese name: Seguro kamome
Mongolian name: Moengoeloeg Tsakhlay

Field mark: 56 cm. Large gull (much larger than a crow). Mantle is gray in varying shades (from slate-gray to light gray) with black tips; remaining plumage is white. Bill yellow with red spot on gonion of lower mandible. Legs pink or yellow. Juveniles are mottled brownish-gray with lighter underparts.

habits: Herring gull is found in a variety of habitats from tundra to desert and prefers valleys of large rivers during migration. In the north, it is migratory; in the south, nomadic or nonmigratory. It is common and numerous in places. It nests in colonies or separate pairs on cliff shores of seas and on islands, often together with other gulls and alcids; on sandy or sity spits of land, and on small islands in steppe lakes; in tundra, on heaps of reeds or hummocks; in swampy lowlands near lakes and on river islands. Its nest is made of dry grass and feathers and is situated in inaccessible cliffs, on gentle, grassy slopes, or on flat, lichen-covered areas. Its start of nesting depends on region, and begins mid-April until the end of June. It lays two or three brownish-green or ocherish-olive eggs with dark spots. It is fairly aggressive near the nest, but on the whole very wary. Its call is a laughing "ha-ga-ga" (in flight; loud "ceah-ceah-ceah" that is emitted on the ground while the bird leans its head back and opens its bill wide; or, occasionally, a throaty "kyaoo", emitted in flight when alarmed. It feeds on a variety of prey: fish, aquatic invertebrates, commercial fishing waste, and hunting offal; on dry land, it hunts for susliks, voles, lizards, insects; on seas, it follows fishing vessels; also feeds on nestlings and eggs of other birds; carrion, berries.

Sites: 17pk9-19pk2, 65-69km, 255km, 272km, 315km, 465km

12. Black-headed Gull (*larus ridibundus*)
Japanese name: Yuri kamome
Mongolian name: Khueren Tolgoyt Tsakhlay

Field marks: 37 cm. Medium-size gull (size of a crow). Head is coffee-brown; mantle gray; outermost primaries white with black tips and black undersides; remaining plumage is white. Bill and legs red. In winter, head is white with brownish spot behind the eye. Juveniles have brownish upperparts and white underparts; tips of primaries black; dark terminal band on tail.

Habits: Black-headed gull is found in a variety of habitats from forest to desert; also in river valleys during migration. It is migratory, and one of the most common gulls. It nests near lakes, marshes, lagoons , and in old river beds; it prefers places where there is lush vegetation near water. It forms large colonies, often together with other gulls and terns. Its nest is made of grass and is situated on a floating mat, in broken reeds, or on a hummock; sometimes on dry, grassy, or sandy islets. It lays three greenish-brownish or light olive-bluish eggs with dark brownish spots from mid-April to May. It circles overhead with alarmed cries when intruder approaches nesting colony; circles aggressively. Its call is a harsh, chirring "kyarr". It feeds from the surface of the water by flying low, or swimming; it often searches for food on land. It feeds on aquatic and terrestrial insects and their larvae, small fish (usually dead or

sick), often on rodents (voles).

Sites: 315km, 335km, 420-421km

13. Common Tern (*Sterna hirundo*)
Japanese name: Ajisashi
Mongolian name: Kharaalay

Field marks: 35 cm. Medium size; wings very long and narrow. Outer tail feathers greatly elongated; upperparts gray; underparts white with grayish sides; black "cap" on the head; legs red or red-brownish; bill red with black tip, sometimes entirely black (in eastern races). In winter, forehead is white; upperparts lighter; bill blackish. When bird is sitting, tips of folded wings reach tip of tail.

Habits: Common tern is found in a variety of habitats from forest to desert. It is migratory, common and numerous. It nests on sandy and pebbly spits of land and on islands in seas, rivers, and lakes, on reed-covered flats (on lower reaches of rivers), in boggy meadows. It nests in colonies; sometimes singly. Its nest is situated on flat, sandy beaches or on heaps of reeds. It lays three ocherish eggs with black spots from mid-May until June. It is very aggressive near the nest, attacks intruders, and chases away raptors. Its flight is light and direct, it usually hovers before diving for fish near the water surface (it seldom becomes completely submerged); it rarely sits on water. Call: harsh, unpleasant "kirryaya" or quiet "kee-kee-kee". It feeds on aquatic invertebrates, small fish, flying insects.

14. Wood Pigeon (*Columba palumbus*)
Mongolian name: Oyn Tagtaa

Field marks: 41 cm. Much larger than Rock Pigeon. Coloration dove-gray; breast pink-gray; white patches on neck and wings; dark, wide terminal band on tail; bill yellow with reddish base and white cere; legs raspberry-red.

Habits: Wood pigeon is found in mixed, deciduous, or coniferous forests, more rarely in forest-steppe. It is migratory and not numerous. It nests in pairs, usually in dense and rarely visited sections of the forests. A thin, loosely constructed nest is made of twigs and situated in a tree, sometimes high near the trunk or on a branch. It lays two white, large eggs from end of April on (later in the north); multibrooded. It flocks during non-breeding season. It flies like

other pigeons, but appears slower and unhurried. It is very wary, even near the nest. It often perches in the open on tall trees; on low trees, stays hidden. Call: a very loud, hooting, rhythmical "hoo, oo-rooora, hoo, oo-rooo-ra, hooo-ra". It feeds on seeds and grain from fields.

Sites: 223km, 272km, 420-421km, 465km

15. Rock Pigeon (*Columba livia*)
Mongolian name: Khoekhvoer Tagtaa

Field marks: 34 cm. Coloration is a dark bluish-gray; wings light gray with two broad dark stripes; dark terminal band on tail; whitish rump. In semi-tame Rock Pigeon, plumage is often variable.

Habits: Rock pigeon is found in settled areas, mountain habitats, steppe, and desert. It is nonmigratory, or nomadic in places. It is Common and numerous. It nests in colonies along cliffs or clay precipices, in caves, deserted buildings and wells, in towns and other settled areas --- in attics and eaves of roofs, in towers, bell towers, etc. Its nests is situated either in the open on a ledge or cornice, or in burrows, clefts, and niches. Nest is flat, loosely made of twigs and feathers. It lays two white, shiny eggs from February or March on. It is multibrooded; it may nest three to four times. It occurs in flocks. Its flight is very fast and strong, with frequent, deep wing beats; agile flier; its takeoff is often accompanied by loud flapping of wings. Call: gurgling coo; also emits a faint "voi" near the nest, resembling a drawn-out "oo-oo-oo" (with emphasis in the beginning). It feeds on the ground and prefers seeds of a variety of plants (including cereal crops).

Sites: 208-209km, 255km, 272km, 285km, 358km, 399km, Dund river (park, Ulaan-baatar), 420-421km, 429-430km, 434-435km

16. Western Stock Pigeon (*Columba oenas*)
Mongolian name: Khuenkhel Tagtaa

Field marks: 34 cm. Resembles Rock Pigeon, but has gray rump and reduced wing stripes and dark underwings; bill is yellowish.

Habits: Western stock pigeon is found in deciduous and mixed forests. It is migratory and not

numerous. It nests in pairs along edges of old, primarily oak forests, and in groves; it avoids thick, forested areas. Its nest is situated in a tree hollow, often high above the ground, and is not lined by the bird, who uses whatever material is available in the hollow already. It lays two white eggs from end of April on; it is multi-brooded. It stays in flocks during non-breeding season. It flies like other pigeons, but a characteristic whistling sound of the wings is heard during takeoff. It is very wary and hard to see in the forest. Call: a loud, hoarse "hoo-hooo", which is repeated several times in a row. It feeds on the forest floor; during the latter half of the summer, in open fields. It feeds on various seeds.

Sites: Dunt river (park, Ulaan-baatar)

17. Daurian Partridge (*Perdix dauuricae*)
Mongolian name: Daguuruin latuu

Field marks: 28 cm. Resembles Gray Partridge, but side of head, throat, and upper breast ocherish; spot on belly is black or dark brownish; in fall and winter clumps of stiff, narrow feathers form along the sides of the chin ("beard").

Habits: Daurian partridge is found in open spaces alternating with overgrown thickets, in a variety of habitats from forest to desert, and settled areas. It is non-migratory, common. It is numerous in places. It stays in pairs (monogamous); at wintertime in flocks. It nests at edges of fields overgrown with thickets or tall weeds, in ravines and gullies in steppe, in dry meadows, young forests along side meadows, clumps of birch, and islands of woods in steppe. It nests on the ground hidden in tall grass or under a bush. It lays fourteen to twenty (even up to twenty-four) eggs of a uniform grayish or cherish-olive color, end of April and later. Incubation and parental duties are shared by both parents; bird sits on nest firmly, flushing reluctantly only on close approach. It feeds on the ground in open places. Its flight is straight and swift; a flock takes off from the ground with a characteristic fluttering noise. Call: loud, repetitive "kirr-rek, kirr-rek". It feeds on seeds and shoots of various plants (including cereal grains), insects.

Prohibited hunting seasons: from March 16th to September 1st.

Sites: 10pk6-10pk8, 208-209km, 255km, 272km, 285km, 289km,315km, 358km, 420-421km, 442-443km

18. Red-rumped Swallow (*Hirundo daurica*)
Japanese name: Koshiaka tsubame
Mongolian name: Mongol Kharaatsay

Field marks:18-20 cm. Top of head, back, wings, and tail blue-black; nape and upper tail coverts rusty red; underparts ocherish with narrow brownish streaks. It has long, forked tail.

Habits: Red-rumped swallow is found in steep river valleys, hills, villages, and towns. It nests in cliffs, precipices, or walls and under eaves of houses. It is migratory and common. It flocks during flight or while perched on wires, cliff ledges, or dead tree branches, etc. The clay nest is fastened to a wall and is in the shape of a bottle with one or several entrances. It lays five or six white eggs in May or June. Call: quiet chirping. Song: chirping and sounds reminiscent of a cat's meowing.

19. Eagle Owl (*Bubo bubo*)
Japanese name: Washi mimizuku
Mongolian name: Shar Shuvuu

Field marks: 67 cm. Very large owl with well-developed "ears". Coloration variable; upperparts from dark rufous with black mottling to an ocherish with blackish streaks over fine, dark barring on sides and belly; legs feathered to the claws; eyes orange-yellow.

Habits: Eagle owl is found in a variety of habitats from taiga to desert and mountains; it inhabits from taiga to desert and mountains; it inhabits all unpopulated, remote areas, and avoids contact with people. It is nonmigratory or nomadic. It is generally rare. It nests in cliffs, in inaccessible parts of the forest, in ravines, in rock slides, under precipice. Its nest is on the ground, in hollows or rocky ledges, in hollow trees; it occasionally uses nest of a raptor. It lays two or three white eggs in April, searches for prey in flight or while perched in tree. Its flight is slow, silent, usually low to the ground. Call: a loud, distant "oo-hoo".

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Sites: 17pk9-19pk2, 272km, 285km, 289km, 420-421km

20. Black Woodpecker (*Dryocopus martius*)
Japanese name: Kuma gera

Mongolian name: Khar Tonshuul

Field marks: 45 cm. Large, size of a crow. Matte black; eyes white. Male has a raspberry-red crown; the female has a red nape.

Habits: Black woodpecker is found in mature coniferous and mixed, sometimes deciduous forests. It is nonmigratory and not numerous. It nests in a hole in a tree, hollowed out by the bird; its nest is usually situated high above the ground, and the entrance to the nest is at a right angle to trunk. It lays three to five white eggs in April or May. The spring "drumming" is very loud, low in tone. It is found singly or in pairs; it climbs tree trunks and stumps by hopping up the trunk. It is wary. Call: loud "kree-kree-kree" or plaintive, nasal "klyoue". It feeds on insect larvae and ants.

Sites: 272km, 285km

21. Lesser Spotted Woodpecker (*Dendrocopos minor*)

Field marks: 14 cm. Small (sparrow-size) woodpecker. Heavily barred black and white upperparts; underparts white with black streaks. Male has red crown; female, black.

Habits: Lesser spotted woodpecker is found in deciduous and mixed forests, parks, gardens. It is nonmigratory and nomadic. It is common. It nests in a tree hollow that the woodpecker often digs out of rotten trees low to the ground. It lays five to eight white eggs in May or June. It stays singly and in pairs, in trees, climbing along branches and rarely on trunks. In winter, it is nomadic together with tits. Call: loud "kee-kee-kee-kee-kee" blending together, resembling cry of a small hawk. It feeds on various insects.

Sites: 285km

22. Hoopoe (*Upupa epops*)
Japanese name: Yatsugashira
Mongolian name: Oeboeoelj

Field marks: 28-32 cm. A little larger than a pigeon. Bill thin, long, slightly downcurved. Large fan-shaped crest on the head; wings wide and rounded, boldly marked with black-and-white stripes; tail black with single broad white band; lower belly and undertail coverts

whitish; remaining plumage brownish-pink, brighter on the breast and on the crest.

Habits: Hoopoe is found in thinly wooded open spaces, in groves and thickets, gardens and parks. It is migratory and common. It nests in a tree hollow, on a heap of rocks, in niches of cliffs and precipices, in burrows. It lays three to nine grayish eggs from April to June. It is found singly, in pairs, and small groups on the ground or in trees and bushes, often near settled areas. Its flight is fairly slow and undulating. It feeds on the ground on insects and other small invertebrates. Call: muted "up-up-up" and a harsh hissing.

Sites: 272km, 285km, 420-421km, 465km

23. Eurasian Cuckoo (*Cuculus canorus*)
Japanese name: Kakkoo
Mongolian name: Khoekhoeoe

Field marks: 33 cm. Smaller than a pigeon. Upperparts, head, throat, and upper breast gray; underparts white with narrow, blackish barring; white terminal tips to tail feathers. Underwings whitish; marginal coverts at wrist of wing are white with black barring. Females have two color phases: gray and, more rarely, rusty.

Habits: Eurasian cuckoo is found in forest and thickets in variety of habitat. It is migratory and common. It is solitary; rarely in pairs. It lays eggs in nests of other birds (thrushes, warblers, wagtails, flycatchers). Its eggs often resemble those in parasitized nests, but are usually larger. In flight, it resembles a Eurasian sparrowhawk. When calling, male cocks its tail up and lowers its wings. Call of male: the well-known "cuck-coo"; call of female is a loud trill, "klee-klee-klee". It feeds on various insects and their larvae, also on fuzzy caterpillars.

Sites: 272km, 285km

24. Mongolian Lark (*Melanocorypha mongolica*)
Mongolian name: Mongol Boljmor

Field marks: 20-22 cm. It resembles White-winged lark, but noticeably larger, with large black patches at the sides of the throat.

Habits: Mongolian lark inhabits steppe, preferring damp areas with lush grass. It usually

migrates. It is solitary nester; the rest of the time is spent in flocks. It nests on the ground. It lays three or four grayish eggs with brown spots in May or June. It sings in flight. Song: a selection of trills.

Sites: 244-245km, 255km, 272km, 285km, 315km, 399km, Dunt river (park, Ulaan-baatar), 420-421km, 429-430km, 434-435km

25. Northern Skylark (*Alauda arvensis*)
Japanese name: Hibari
Mongolian name: Borolzoy Boljmor

Field marks: 17-20 cm. Somewhat larger than a sparrow. Coloration of upperparts ocher and interspersed grayish-brown, with finely streaked head and nape, and broader blackish streaks on the back; underparts ocher-white with fine brownish streaks on the breast. A noticeable wide crest. White outer tail feathers.

Habits: Northern skylark is found in open country, where it inhabits farmland, grassland, plains, alpine meadows. It commonly migrates. It stays in pairs or flocks and nests in a hole or depression in the ground. It lays four or five grayish or reddish eggs with dark spots, April to June. Call: a soft "chri-ik" or "chrr-ik". Song: a variety of loud trills.

26. White Wagtail (*Motacilla alba*)
Japanese name: Haku sekirei
Mongolian name: Khoekh Tsegtsgiy

Field marks: 18 cm. In adults, top of head, throat, upper breast, tail, and wings are black; back is gray or black: forehead white, as is wide band through the eye to the ear (and occasionally sides of the head): outer tail feathers, some wing feather edgings, and entire underparts white. Juveniles are gray without black markings.

Habits: White wagtail is found in wetlands, shores of reservoir, ponds, and larks, and inhabited areas. It is common. It is numerous in places. It stays singly and in pairs; in flocks during migration. It is usually seen on the ground and on rocks, but sometimes perches in bushes and trees. It nests in hollows of dead trees, under eaves, in niches and cracks in cliffs and precipices, etc. It lays five or six eggs with gray spots, April to July. Call: a loud "tsiti-tsuri" and a short "cherlich". Song: repetition of these sounds.

Sites: 10pk6-10pk8, 17pk9-19pk2, 255km, 272km, 285km, 289km, 315km, 399km, 420-421km

27. Bohemian Waxwing (*Bombycilla garrulus*)
Japanese name: Kirenjaku
Mongolian name: Enkht Bialxuukhay

Field marks: 18-23 cm. Size of a starling. Conspicuous crest. Thick, fluffy feathering. Pinkish-gray overall; wings black with narrow yellow and white marking; secondaries with waxy red tips; tail, throat, and eyeline black; undertail coverts rufous; tip of tail yellow.

Habits: Bohemian waxwing is found nesting in pine and birch woods. When wandering, it is found in any type of woods, gardens, and parks. It is nomadic common. It is in pairs during the breeding season, otherwise in flocks. It nests in trees. It lays three to seven gray-blue eggs with small black spots in May or June. Call: soft "sveereeree-sveereeree". It feeds on insects, which are often caught in flight, and berries.

Sites: 255km, 420-421km, 442-443km

28. Northern Raven (*Corvus corax*)
Japanese name: Watari garasu
Mongolian name: Khon Kheree

Field marks: 62-64 cm. Large bird (much larger than a crow). Black with metallic bluish luster; tail wedge-shaped. In desert races, head, neck, back, and upper breast have chocolate-brownish tint. Some ornithologists consider it a separate species.

Habits: Northern Raven is found in forests, river valleys, seashores, mountains, and desert. It is nonmigratory. It is not numerous. It occurs singly, in pairs, or small flocks. It nests in trees, cliff ledges, or precipices. It lays three to seven light greenish-blue eggs with brownish spots from February to May. Call: loud "krook-krook" and cawing. It feeds mostly on rodents, insects, carrion.

Sites: 208-209km, 244-245km, 255km, 272km, 285km, 465km

29. Eurasian Crow (*Corvus corone*)
Japanese name: Hashiboso garasu
Mongolian name: Khar Kheree

Field marks: 47-48 cm. Divided into two races, black and gray. The black race is uniformly black with bluish metallic glint. The gray (hooded) race has black wings, head, and tail and the rest of the plumage is gray. Some ornithologists consider them separate species.

Habits: Eurasian crow is found in all habitats, especially settled areas; in places it lives only in inhabited areas. It is nonmigratory, nomadic or migratory. It is common. In breeding season, it stays in pairs; in flocks the rest of the year. It usually feeds on the ground. Its nest is situated in trees, more rarely on rock ledges or heaps of cattails. It lays four or five light greenish-blue eggs speckled brownish from March to June. Call: hoarse "karr-karr".

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 54-56km, 65-69km, 110km, 170km, 208-209km, 223km, 255km, 272km, 285km, 289km, 315km, 335km, 258km, 399km, 420-421km, 429-430km, 434-435km, 442-443km, 465km

30. Jackdaw (*Corvus monedula, Corvus dauricus*)
Mongolian name: Khar Alagtuu

Field marks: 33-36 cm. Crown and neck gray; remainder has dark blue metallic sheen on back and shoulders.

Habits: Jackdaw is found in settled areas, thin forests, open spaces with cliffs and precipices. It is nonmigratory, nomadic, or migratory. It is common; in place numerous. It is gregarious, often together with Eurasian crows and Eurasian rooks. It nests in pairs and in colonies. Its nest situated in tree hollows, under roofs, in pipes, burrows in precipices and cliff crevices. It lays four to six light bluish-green eggs speckled brownish from April to June. Call: loud "caw-caw".

Note: In Tuva, the Transbaikal, and in the Soviet Far East, there are two races of jackdaw: one is significantly darker, particularly the head; the other has head, wings, and tail black, with rest of the plumage nearly white. Some ornithologists consider the eastern jackdaws as a separate species.

Sites: 10pk6-10pk8, 17pk9-19pk2, 30-32km, 92-96km, 110km, 170km, 223km, 235km, 244-245km, 255km, 272km, 285km, 315km, 335km, 358km, 399km, Dunt river (park, Ulaan-baatar), 420-421km, 429-430km, 434-435km, 429-430km, 442-443km

31. Red-billed Chough (*Pyrrhocorax pyrrhocorax*)
Mongolian name: Ulaan Khoshuut

Field marks: 45 cm. Black with dark bluish sheen. Long, slightly downcurved bill; legs are coral-red. Wings long and tail short.

Habits: Red-billed Chough is found in open mountain areas; it prefers meadow steppe and plowed fields. It is nonmigratory and common. It stays in flocks. It nests in creviceor niche of cliff. Lays three to nine grayish-green eggs speckled brownish from April to July. Call: loud "klyaa-klyaa". It feeds on the ground.

Sites: near Ulaanbaatar

32. Black-billed Magpie (*Pica pica*)
Japanese name: Kasasagi
Mongolian name: Shaazgay

Field marks: 45-48 cm. Medium-size bird (like Jackdaw) with long, graduated tail. Head, neck, upper breast, back, rump, tail, and wings black with iridescent gloss; breast, belly, large shoulder, and wing patches white.

Habits: Black-billed magpie is found in wooded and thicket areas in a variety of habitats. It avoids deep forest. It stays singly, in pairs, and in flocks. Its flight is heavy with frequent beats of its short wings. It raises tail when walking on the ground. Its roofed nest is situated in bushes or trees. It lays five to eight light bluish-greenish eggs with brownish spots from April to July. Call: loud, harsh chattering.

Sites: 10pk6-10pk8, 17pk9-19pk2, Sukhe-baatar, 30-32km, 54-56km, 65-69km, 92-96km, 110km, 208-209km, 223km, 235km, 244-245km, 285km, 315km, 335km, 399km, Dunt river (park, Ulaan-baatar), 420-421km, 429-430km, 434-435km, 429-430km, 442-443km

33. Golden Oriole (*Oriolus oriolus*)
Japanese name: Koorai uguisu
Mongolian name: Shargatsh Bialzuukhay

Field marks: 24-27 cm. In male, wings, tail, and lores black; outer corners of tail, spot on wings, and remaining plumage bright yellow. In females and juveniles, upperparts yellowish-green; underparts yellowish-white with narrow, brownish streaks.

Habits: Golden oriole is found in thin deciduous and mixed forests, gardens, and parks. It is migratory and common. It is found singly, in pairs, and more rarely in small flocks. It stays hidden in leafy part of trees. Its nest is a basketlike pouch with a "bolster" along the inner rim, hung from tip of tree branch. It lays three or four white eggs speckled black in May and June. It is easily identifiable by call, which is a harsh "vzhyaya-aa", and beautiful flutelike whistle, "flew-teeyou-leyou".

Sites: 10pk6-10pk8, 255km, 272km

34. Northern Treecreeper (*Certhia familiaris*)
Japanese name: Kibashiri
Mongolian name: Tsamuin Bialzuukhay

Field marks: 12-15 cm. Upperparts rufous-brown with whitish streaks and unstreaked rusty rump; wings with light irregular markings; underparts white. Claw of rear toe is no shorter than 9 mm.

Habits: Northern treecreeper is found in coniferous and mixed forest in plains and hills. It is nonmigratory and nomadic. It is common. It is found singly and in pairs; it climbs on tree trunks. It nests in stump or behind loose bark. It lays five to eight white eggs with small red-brown spots from April to June. Call: quiet "tsee-tsee". Song: loud trill.

Sites: 272km, 285km

35. House Sparrow (*Passer domesticus*)
Mongolian name: Orongiyn Bor Shubuu

Field marks: 14 cm. In male, crown is gray; throat and upper breast black; upperparts

chestnut-brown; underparts whitish; cheeks and single wing bar white. Females and juveniles brownish-gray overall; lighter underparts; back with black streaks.

Habits: House sparrow is found in settled areas, where it lives in towns and villages; in central Asia, it is found near ravines and precipices. It is nonmigratory, but migratory in central Asia. It is numerous. It stays in flocks; it often nests in colonies. It nests under roofs and in house cracks, artificial nesting boxes, in burrows along slopes of gullies, and in precipice walls. It lays five or six white or light grayish-blue eggs with brownish spots from April to July. Call: loud "dzheev-dzheev".

Sites: 289km, 358km, 399km, Dunt river (park, Ulaan-baatar), Bayazuth bridge, 420-421km, 429-430km, 434-435km, 442-443km, 465km

36. Tree Sparrow (*Passer nontanus*)
Japanese name: Suzume
Mongolian name: Kheeriyn Bor Shubuu

Field marks: 14-15 cm. Smaller than a House Sparrow. Back dark brown with dark known streaks; wings and tail brownish; crown chestnut-brown; sides of head white; throat and cheek spot black; underparts whitish.

Habits: Tree sparrow is found in settled areas, where it prefers young tree plantings during breeding season; barnyards and crop sowings the rest of the year. It is nonmigratory and common. It stays in flocks. It nests in pairs and in small colonies. It nests in tree hollows, under roof eaves, burrows in precipices, artificial nesting boxes, and near rim of nest of large raptors. It lays four to eight white or grayish eggs speckled dark from April to July. Call: harsh "chirr-chirr".

Sites: 10pk6-10pk8, 17pk9-19pk2, 30-32km, 54-56km, 65-69km, 92-96km, 208-209km, 255km, 272km, 285km, 335km, 358km, Dunt river (park, Ulaan-baatar), Bayazuth bridge, 420-421km, 429-430km, 434-435km, 429-430km, 442-443km

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