KATMAI NATIONAL PARK - survey report of 15-29 April 1989

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PURPOSE: Determination of the intertidal fauna and population dynamics, especially molluskan, on the marine shores of Katmai National Park, Alaska for the purpose of evaluating the affects of the Exxon Valdez oil spill of 24 March 1989.

OBJECTIVES:
A. Molluskan species composition.
B. Population dynamics of the mollusks.
C. Utilization of mollusks by wildlife.
D. Determine presence of oil and to collect samples of the oil.
E. Collect data on mortality of wildlife, both winter kill and oil caused.
F. Observations of fish, birds and mammals of the area.

METHODS:
Visual, on the ground foot surveys of the beaches of the Katami National Park.

Transportation to the beach sites were made by small skiff or helicopter.

A section of the beach was walked and surveyed. Dependent on the stage of the tide, generally the first trip was near the water's edge, then the high tide drift line of the previous high tide of the present series, which usually occurred early on the morning of the day the survey was conducted, and last a survey of the storm drift line (believed to be than of November, 1988). Usually the 3 sections were covered in 3 passes along the beach, although it was done in a single zig-zagging pattern when there was a long section of beach to cover, when the tide was near high water and the recent drift line was easy to review from higher on the beach.

Oil, believed to be from the Exxon Valdez spill was mapped and samples were collected and handled using standard methods prescribed by the Park Service.
Oil density on the beach was classified by the number and/or size of the oil drops on the beach in a lineal cross section perpendicular to the beach:

very light - less than 3 spots of oil per meter
light - 4-50 spots or small patches of oil per meter
moderate - 51-150 spots or patches of oil per meter, none much larger than 250mm, nor much thicker than 4mm.

heavy - single patches of oil larger than 250mm, oil almost continuous along the beach, oil pooling in places deeper than 5mm.

very heavy - oil continuous along the beach, oil strip more than 2m in width.

Because of the inability to get on the beaches during low tide, it was not possible to make beach transects from the low tide line to the top of the beach. Therefore, only information on relative abundance of the mollusks was obtained.
RESULTS:


Area surveyed:
   The whole of the shore line around Nordyke Island was walked.

Oil contamination:
   None at time of survey.

Area description:
   There is a wide beach terrace around most of the island that is from 103m to 1km wide. This terrace is fairly level at about the mean tide line. The terrace is bed-rock, composed of the cemented conglomerate that the rest of Nordyke Island is. There are 3 small beaches on Nordyke that give a steep access to the top of the island, with most of the terrace ending in an unscaleable cliff. The terrace has a very few, small loose rocks on it. In a few places there are small strips of sandy-mud or fine gravel, but generally the whole of the terrace is hard, lumpy rock. There are a few, shallow tide pools on the terrace.

   Vegetation is quite limited. In addition to the eel grass there were thinly scattered, stunted marine algae, Fucus, Ulva, a short sack-like brown, a short branching red, and the pink incrusting.

   The terrace has a large population of the snail Littorina sitkana, a moderate population of the snail Nucella lima, and a small population of the blue mussel, Mytilus edulis. All species of mollusks on this terrace are noticeably small for their size. From scat remains on top of the island and from observations of the sea ducks and gulls utilizing the area these 3 intertidal mollusks are an important food being used in the area. Other species of mollusks from lower than I was able to examine were also being used for food.

   At the Nordyke Island Anchorage I made a series of attempts to obtain a bottom sample in the area that the sea ducks, mainly white-winged scoters, were using to feed. Because of the very hard clay bottom very little was obtained.

   Because the Nordyke Island Anchorage is the only anchorage in the area, it gets quite a bit of used at times. On 17-19 April during the herring commercial fishery there were as many as 25 tenders and 22 fishing boats with 8 aircraft using this small anchorage.

   Besides mollusks, the crab Telmissus was being utilized by Lutra canadensis. Undoubtedly this crab is also being use by Enhydra lutris. Remains of this crab were found in the Lutra scats on the island and their cast shells were found on the shore.
Nordyke Island. 15 April 1989. Tide level: low flood. (continued)

There are some narrow beds of small eel grass growing in a few places on the terrace. In 1959 it was noted that the black brant goose utilized this eel grass in late May to a great extent, both on the Nordyke terrace and the terraces of the 2 nearby small islands.

Mollusks of Nordyke Island:
Bivalves:  
Live:  
  *Mytilus edulis*

Dead:  
  *Clinocardium californiense*  
  *Clinocardium nuttalli*  
  *Hiatella arctica*  
  *Macoma balthica*  
  *Macoma inquinata*  
  *Macoma obliqua*  
  *Mya arenaria*  
  *Mya truncata*  
  *Spisula polynyma*  
  *Tellina lutea*  
  *Tritonia borealis*

Gastropods:  
Live:  
  *Littorina sitkana*  
  *Lottia borealis*  
  *Lottia pelta*  
  *Nucella lima*  
  *Tectura persona*  
  *Tectura scutum*

Dead:  
  *Buccinum baeri*  
  *Margarites pupillus*  
  *Neptunea lyrata*  
  *Velutina velutina*

Chitons:  
Dead:  
  *Cryptochiton stelleri*  
  *Mopalia cf. hindsi*  
  *Tonicella lineata*

Area surveyed:
Small section of beach from edge of terrace to shore, about 500 m.

Oil contamination:
None at time of survey.

Area description:
Wide flat terrace of cemented conglomerate rock. About 35% of area is shallow tide pools. Small amount of narrow sandy-mud areas with small eel grass grow on it. Very few loose rocks on terrace. Beach narrow, bordered with cliffs, covered with snow. Terrace like that of Nordyke Island with a moderate population of the stunted Littorina sitkana and the stunted algae.

Did not appear to be as greatly used as the Nordyke terraces, but did have use by the sea ducks.

Mollusks:
Bivalves:
Live:
Mytilus edulis

Dead:
Clinocardium nuttalli
Macoma balthica
Macoma obliqua
Mya arenaria
Spirolocula polynyma

Gastropods:
Live:
Littorina sitkana
Lottia borealis
Nucella lima
Tectura persona
McNeil Head, about 1km west on small beach. 16 April 1989. Tide level: high.

Area surveyed: High tide line on short beach.

Oil contamination:
  None at time of survey.

Area description:
  High beach of coarse gravel and small cobble.

Mollusks:
  Bivalves:
    Dead:
    Clinocardium nuttalli
    Macoma balthica
    Mytilus edulis
    Mya arenaria
    Siliqua patula (with part of abductor muscles present)

  Gastropods:
    Dead:
    Littorina sitkana
    Tectura scutum
    Velutina velutina
McNeil Bay. 17 April 1989. Tide level high flood to high tide.

Area surveyed:
From the tip of McNeil Spit to the first cliffs on the south side of McNeil Bay, distance about 1.2km.

Oil contamination:
None at time of survey.

Area description:
Beach near the high tide line was coarse sand and gravel. Beach covered with varying sized chunks of ice. At high tide level the shore ice and snow was about 0.6m deep.

Comments:
Mollusks indicate the offshore area is muddy-sand. Utilized by sea ducks and probable at low tide by ducks and geese feeding on Macoma balthica.

Mollusks:
Bivalves:
Dead:
Clinocardium nuttalli
Macoma balthica
Macoma inquinata
Mytilus edulis
Mya arenaria
Mya uzenensis

Gastropods:
Dead:
Buccinum glaciale

Area surveyed:
From the mouth of the slough located about 3.2km northeast along the beach from the mouth of Douglas river to and around the "Y" shaped Island and back along the shore to the starting location.

Oil contamination:
None at time of survey.

Area description:
The area to the island was almost flat, sandy-mud with few tide pools. The area inside the top of the "Y" on the island was muddy with some flat, level bed-rock. There was a small amount of short eel grass in this area. The outside of the island was a wide, 0.6 to 1.5km sand flat. Mainland shore line was coarse sand and gravel.

Comments:
The inside sandy-mud area was the Macoma balthica type of habitat. Here a medium sized canadian goose and white-front geese were observed feeding. Their food appeared to be the Macoma balthica based on observations else where on the flat where geese had been feeding. The muddy area on the island was being utilized by mallard and pintail ducks that were feeding on the eel grass and on the very prevalent polychaete worms that were in the mud. The outside area was typical razor clam sand flats. Although the tide was too high to get to the clams there were quite a few dead Siliqua patula shells on the flats and beach. Most of the Island edge is too high for mollusks, but at the southerly end there were a few mollusks lining on the fine sand-stone of the island.

At the starting location there was the very old skeleton of a beaked whale, Mesoplodon stejnegeri or maybe Berardius bairdi on the beach.
One winter-killed Enhydra lutris skeleton on the beach. Bone marrow cavity in large bones without any fat.

Mollusks:
Bivalves:
Live:
  Macoma balthica
  Mytilus edulis
  Mya arenaria
Dead:
  Siliqua patula
  Spisula polynyma
  Tellina lutea

Gastropods:
Live:
  Liottorina sitkana
  Nucella lime
Dead:
  Fusitriton oregonense
Point East of Douglas River, off Spotted Glacier.

Area surveyed:
Beach from tip of point southward about 4.8km.

Oil contamination:
At about 3.2km south of point the first sign of Exxon Valdez oil was found. It consisted of a Japanese sandal that had 4 splotches of oily mousse on it, sample #201. No other oil seen in immediate vicinity. About 200m further down the beach a top, styrofoam lid to an egg carton was found that was completely covered with oily mousse, sample #202. Again no other oil on the beach in the vicinity. About 150m further down the beach blobs of oily mousse were found for a distance of about 100m. Density of the blobs was very light, although some of the blobs were as large as 150mm x 62mm. Thickness of the blobs was about 3mm. All oil was at that mornings high tide line.
Second beach was free of oil at the time of the survey, third beach was not walked except for the first 150m, and when observed with 10 x 30 binoculars the whole beach appeared to be free of oil at the time of the survey.

Area description:
Beach was coarse gravel to large, loose cobble. It was very hard walking because of its loose consistency. Water from small streams freely ran through the loose cobble and did not form a channel to the open sea.

Comments:
It appeared that there was very little utilization of this area. There were a few-off shore sea ducks, the brown bear trail along the beach was not extensively used, there was one family of Lutra canadensis using the area and what appeared to be a single red fox.

Mollusks:
Gastropods:

Oslotriton oregonense
Shaw Island. 21 April 1989. Tide level low flood.

Area surveyed:
   The whole of the shore of Shaw Island except for a distance on the side facing the main land where the cliffs prevented access, that is to U.S. Coast & Geodetic Survey Bench Mark 1965. Total coverage of the shores of Shaw Island was about 90%.

Oil contamination:
   Light oil contamination on all sides of Shaw Island that could be surveyed. Binoculars were used on the unsurveyed areas and no oil was detected. Oil samples were taken from: bed-rock area facing Cape Douglas, sample #205; sample #206 from beach facing Augustine Island; sample #208 from north side, west-central beach. All samples taken from the only oil zone on the beaches, that is from this mornings high tide line.

Area description:
   Shaw Island beaches are a mixture of very rough bed-rock and large cobble and boulders with a few areas of large gravel. There is a small amount of bed-rock terrace on the north side with its typical terrace species of mollusks.

Comments:
   There is more utilization of the small ponds on the top of the island than there was of the waters around the island. Dabbling ducks, black brant, swans, and gulls were using these fresh water ponds. Both pintail ducks and black brant were using the terrace area for feeding on what appeared to be Littorina sitkana. Further off shore were a few sea ducks. There were a large number of gull on the island and from their scats it appeared that they were feeding on the intertidal mollusks of the area.
   There was a heavy winter kill of Mytilus edulis on the island beaches.
   Very large off shore population of Enhydra lutris. The only food I could tell that they were using was Modiolus modiolus.

Mollusks:
   Bivalves:
       Live:
           Mytilus edulis
   Dead:
       Argiodesma saxicola
       Clinocardium nuttalli
       Macoma balthica
       Macoma obliqua
       Modiolus modiolus
       Mya truncata
       Pododesma macrochisma
       Protothaca staminea
       Saxidomus giganteus
       Serripes groenliadicus
       Spisula polynyma
Shaw Island. 21 April 1989. Tide level low flood. (continued)

Gastropods:
Live:
  Littorina sitkana
  Lottia borealis
  Lottia pelta
  Nucella lima
  Tectura scutum

Dead:
  Buccinum baeri
  Fusitriton oregonese
  Lepeta caeca
  Margarites pupillus
  Trichotropis cancellata

Chitons:
Dead:
  Cryptochiton stelleri
  Katharine tunicata
  Mopalia cf. hindsi
  Tonicella lineata
Kuikpalik Island. 22 April 1989. Tide level low to high flood.

Area surveyed:
   West side beach where the house landing was, about 800m of beach.

Oil contamination:
   Oily mousse was near shore, about 20m out, but the only oil seen on shore was on a large log in the upper intertidal zone.

Area description:
   Beach moderately steep of large boulders with a fine shelly-sand substrate. Bed-rock cliffs at each end of the beach and in the central portion.

Comments:
   A sample of the more common mollusks and fish was taken from this beach. They include: sample #209 of 200 Littorina sitkana; sample #210 of limpets, Lottia pelta and Tectura scutum; sample #211 Buccinum baeri; sample #212 of tide pool fish; sample #213 Mytilus edulis.

Mollusks:
   Bivalves:
      Live:
         Hiatella arctica
         Macoma inquinata
         Modiolus modiolus
         Myxilla cf. beringensis
         Mytilus edulis
         Protosthaca staminea
      Dead:
         Musculus discors
         Saxidomus giganteus

Gastropods:
   Live:
      Buccinum baeri
      Cerithiopsis stejnegeri
      Cf. Discodoris sandiegensis
      Erginus apicina
      Littorina sitkana
      Lottia borealis
      Lottia digitalis
      Lottia pelta
      Nucella lima
      Onchidella borealis
      Onoba cf. asser
      Siphonaria thersites
      Spiromelloaria quadrae
      Tectura persona
      Tectura scutum
Gastropods:
   Dead:
      Fusitriton oregonense
      Lacuna vincta
      Lepeta caeca
      Neptunea lyrata

Chitons:
   Live:
      Katharina tunicata
      Mopalia cf. hindsi

   Dead:
      Tonicella lineata
Kukak Bay. 23 April 1989. Tide level: Low water.

Area surveyed:
Small bay north of north end of Cannery Channel Anchorage.

Oil contamination:
None at time of survey.

Area description:
This small bay has a large flat of muddy-sand and mud with a muddy-gravel or muddy-broken stone shore.

Comments:
The flats are heavily used by sea ducks for feeding on the abundant *Macoma balthica* and other organisms. There was a moderate population of *Mya arenaria* on the flats and a small population of the clams *Mya truncata*, *Saxidomus gigantea*, and *Protothaca staminea* along the shore.

Large population of what appears to be the fish *Anoplarchus purpureascens* was present under the small rocks and amongst the *Mytilus edulis*.

Mollusks:
**Bivalves:**
**Live:**
- *Hiatella arctica*
- *Macoma balthica* very common
- *Macoma inquinata* very common
- *Mytilus edulis* common
- *Mya arenaria* common
- *Mya truncata* common
- *Mysella cf. beringensis*

**Dead:**
- *Clinocardium nuttalli*
- *Saxidomus giganteus*

Gastropods:
**Live:**
- *Buccinum baeri*
- *Discodoris cf. sandiegensis* spawning
- *Littorina sitkana* spawning
- *Lottia pelta*
- *Margarites beringi*
- *Natica aleutica* egg case
- *Nucella lima*
- *Odostomia sp.*
- *Tectura scutum*
Kukak Bay at northern end of Cannery Canal. 23 April 1989.

Area surveyed:
   Anchorage area from back of vessel. Bottom depth about 55 meters.

Oil contamination:
   None at time of survey.

Area description: Bottom soft, gray mud.

Comments:
   A 1 gallon bottom dredge was used and in 5 sets about 6 liters of bottom materials was obtained. It was screened to 0.67mm and all mollusks were picked out. Species and numbers will be reported at a later date as equipment was not available during the field portion of this study.

   Tentative listing of the species of mollusks obtained are:

   Bivalves:
      Axinopsida serricata
      Clinocardium ciliatum
      Compsomyax subdiaphana
      Macoma cf. calcarea
      Nucula tenuis
      Nuculana fossa
      Portlandia sp.
      Yoldia hyperborea
      Yoldia myalis

   Gastropoda:
      Alvinia rosana
      Mitrella gausapata
      Odostomia sp.
      Oenopota turricula
      Solariella obscura
      Turbonilla cf. canadensis

Area surveyed:
The beach from the rocky point on the south side of Swikshak Bay to the third rocky point on the north east side past Big River. The high tide line along the beach was the main area surveyed. The survey of the intertidal sand flat was cut short by the delayed arrival of the helicopter to move me to another area. The area at the south side of Swikshak Bay is of the typical bedrock terrace type with its Littorina siktana ecosystem.

Oil contamination:
None at time of survey.

Area description:
The beach, from about highest low water to the top of the tide line, is moderately steep of gravel. The flat from highest low water to lowest low water is sandy-mud near shore changing to sand on the outer reaches. This flat extends about 2km off shore.

Comments:
The mud clam, Macoma balthica on the inner portion of the flat appeared to be the major food utilized by the sea birds. The outer portion of this flat is the famed Swikshak razor clam beach that has been utilized commercially since the 1920's.

Mollusks:
Bivalves:
Live:
   Macoma balthica
   Mya arenaria

Dead:
   Ariodesma saxicola
   Clinocardium nuttalli
   Macoma expansa
   Macoma inquinata
   Mytilus edulis
   Siliqua patula
   Spisula polymena
   Tellina lutea

Gastropods:
Live:
   Littorina siktana
   Nucella lima

Dead:
   Fusitriton oregonense
   Lottia pelta
   Neptunia lyrata
   Tectura scutum

Area surveyed:
Northerly point of Cape Douglas on the south side of Sukoi Bay along the southeastern shore to about mid way. Distance is about 11.2km of shore line.

Oil contamination:
Exxon Valdez oil mousse was from very heavy to absent depending on beach exposure. (See map for distribution of oil on the beach) Oil contamination was in 3 levels, at high tide line of the highest tide of the recent series of tides which occurred 2 days ago, the second line of oil occurred during yesterday's high tide and the heaviest concentration of oil came ashore on this morning's high tide and was still coming ashore during the afternoon's flood tide with patches of oil mousse as large as 3 x 1.2m just off shore. The oil is coming ashore from the northeast direction and this affects its distribution on the shores of Cape Douglas. Cape Douglas was the first place that dead, oiled birds were found. These birds have been dead for some time as they were quite decayed. Most, 95 of 98, came ashore on this morning's tide.

An Enhydra lutris female with her pup was observed swimming about 0.3m outside a large patch of mousse. She was swimming among small, 10-50mm, droplets of oil mousse. Oil was not noticeable on her or her pup.

Oil sheen was not seen in the water along the shore even among the droplets of oil mousse. There was an onshore wind which would probably blow any oil sheen ashore.

The shore of Cape Douglas was divided into sections and the amount of oil contamination in each section was:
Northeast point to north side of small lagoon:
Oil heavy to very heavy, still coming ashore.
Oil sample #214 taken in this area.
48 oiled, dead murres.
Lagoon to 1st point on south side.
Oil moderate to light.
13 oiled, dead murres.
1st point to old cabin site.
Oil very heavy to moderate.
9 oiled, dead murres.
Old cabin site to point on south side of bight.
Oil heavy to light on southerly portion.
9 dead, oiled murres, 1 live, moderately oiled gull.
Bight to the tip of Cape Douglas (Cape Douglas North).
Oil moderate to light.
9 of 16 live gulls with oiled breasts.
Cape Douglas West to start of next bight.
Oil very heavy for first 150m, then tapering from heavy to light.
3 dead, oiled murres, 1 dead, oiled murrelet.
1st bight or bay on west side.
Oil moderate to light.
1 dead, oiled murre.
1 live, slightly oiled murre.
Cape Douglas. 26 April 1983. Tide level: low to high. (continued)

2nd bay from Cape Douglas on West side.
   Lightly oiled.
1st small bight to the west from the 2nd bay.
   None at time of survey.
2nd small bight to the west from the 2nd bay.
   None at time of survey.
3rd small bight to the west from the 2nd bay.
   None at time of survey.

Area description:
   Most of the area is well weathered bed-rock or boulder with
cobble or coarse gravel beaches. The narrow lagoon and a few
other small ponds were the only fresh water on the high ground of
the Cape area.

Comments: Off shore area heavily utilized by sea ducks for
   feeding. *Enhydra lutris* was moderately common in the area.

Mollusks:
   Bivalves:
      Live:
      *Mytilus edulis*

   Dead:
      *Pododesma macrochisma*

Gastropods:
   Live:
      *Littorina sitkana*
      *Lottia borealis*
      *Nucella lima*
      *Tectura scutum*

   Dead:
      *Buccinum baeri*
      *Fusitriton oregonense*

Chitons:
   Live:
      *Katharina tunicata*

   Dead:
      *Cryptochiton stelleri*
      *Mopalia cf. hindsi*
      *Tonicella lineata*
Problems:
The major problem was the great lack of knowledge about the area or about the job required to be done by most all people
Problems:
The major problem was the great lack of knowledge about the area or about the job required to be done by most all people concerned with this study with the exception of the field crew and the vessel captain who had a little knowledge about the area.
The area we were in is about the most difficult coast to work on in Alaska from the water, other than portions of the eastern Gulf of Alaska and some of the Aleutian Islands. There are very few anchorages for a vessel, few places that an outboard skiff can safely land and remain for a few hours, and the distances an helicopter has to travel to operate in the area are great.
Support staff at ICP or wherever were not knowledgeable about the remoteness of the area, time and tides, and weather conditions. They were apparently unable to interpret the charts and to realize the extent of the intertidal zone and thus the transportation limitations.
There were helicopter scheduling problems in that I was never able to get it early enough to be able to work the low tides. The low tides occur in the mornings and the helicopter seldom got there until a couple of hours after low water.
DISCUSSION:

The marine waters, intertidal terraces, and mud and sand flats of Kamishak Bay - Cape Douglas - Kukak Bay are of a great importance as feeding areas to the spring migration of waterfowl. Heavy oil fouling or indiscriminate clean-up methods to remove the oil will greatly increase the chance of causing major problems with the invertebrate food supply utilized by the waterfowl.

MOLLUSK SPECIES UTILIZED FOR WATERFOWL FOOD BY HABITAT:
Intertidal regions:

High intertidal vegetated marsh.
  None

Low intertidal mud marsh.
  Macoma balthica
  Mytilus edulis

Mud flats in protected waters
  Macoma balthica
  Mya arenaria
  Mytilus edulis

Intermediate zone muddy-gravel areas in protected waters.
  Littorina sitkana
  Mytilus edulis

Open bay sandy-mud flats.
  Macoma balthica

Open Bay sand flats.
  none

Open coast sand flats.
  none

Bed-rock terraces.
  Littorina sitkana
  Mytilus edulis
  Nucella lima

Open coast gravel beaches.
  none

Open coast boulder beaches.
  Littorina sitkana

Open coast boulder, bed-rock beaches.
  Buccinum baeri
  Littorina sitkana
  Nucella lima
Open coast bed-rock.

Littorina sitkana
Limpets

As can be seen there are 2 main molluskan species of major importance as waterfowl food. They are the periwinkle, *Littorina sitkana*, and the mud clam, *Macoma balthica*. The blue mussel, *Mytilus edulis* is used more by the gulls and sea otters than by the waterfowl.

*Macoma balthica* is a filter feeder and *Littorina sitkana* is an algae grazer. I do not know what the affects of the oil will be on these species of mollusks.
Suggestions for future operations in the Cape Douglas area:

I see two methods of operating a resource survey of this area. Both methods are highly dependent on obtaining qualified crews, vessels and having the proper support.

1. Fast method.

Large base vessel. Vessel with showers and laundry facilities, space for 6 investigators. This vessel to basically operate out of Nordyke Island, Sukoi Bay, and Kukak Bay. Vessel to have a good skiff (18' aluminum sea skiff).

Smaller vessel that would sleep 3 investigators plus a crew of 2. This vessel would be of the 32' pocket seiner type that is able to readily go dry during low tide. The areas this vessel would be able to visit for a few days at a time would be McNeil Lagoon, Kamishak River, Douglas River, Slough to the south of Douglas River, Shaw Island, Swikshak River, and a number of the islands in the area. This vessel would have a 14-16 foot sea skiff.

Helicopter support would be needed twice during the survey for a period 3-4 days each time during the period of the minus tides. The helicopter would be stationed with the large vessel and would be at the sole use of the investigators. The pilot and his mechanic would stay on the vessel during this period of time. The helicopter must be ready to transport crews at daylight in the morning.

Six investigators would usually be used in 2 crews for this project.

This method should be able to cover the area in 2 weeks or less.

2. Slow, but much cheaper method.

A single 2 person crew operating out of a small outboard skiff and camping on shore every night. Support would be transporting the crew to McNeil River and picking them up at Kukak Bay, gas cached at a couple of locations, and 2 days of helicopter time. Fixed wing aircraft support would be needed for a complete general survey of the area and then once a week to bring in fresh supplies and to check on the crew. Might be good to bring crew to town every 10 days of so depending on suitable pick-up area, so they can clean up.

Communication would be a problem, but a portable VHF radio would enable the crew to get in touch with the local fishing vessels at most any time and they would be able to relay any emergency messages.

This method would take 6-8 weeks, but would give the best overall coverage of the area. Some aspects of data might be lost because of the lack of specific knowledge in some of the disciplines and the lack of facilities to do water sampling. Because they would be camping at their work site it would be much easier to do a more complete job since if they did not get every thing done in one day they would stay over until it was done.
TENTATIVE LISTING OF MAMMALS OF KATMAI NATIONAL PARK

Habitat:
MO = Off shore Marine
MI = Inshore Marine
IT = Intertidal feeding, living in the coastal spruce zone
B = Muskeg bog
S = Spruce zone
BG = Beach rye grass zone, without spruce trees, to elevation of 5m
R = Riparian willow zone along the creeks, elevation 0-200m
A = Alder zone, elevation 2-400 meters
AL = Alpine zone, above trees and large bushes to upper limit of vegetation, 300m to 800m
O = Absent, or migrates out of the area for the winter
? = Unknown, including unknown distribution and unknown presence
H = Hibernates during the winter
T = Tundra

Order INSECTIVORA
Family SORICIDAE
  Sorex araneus, Arctic shrew     BG,R,A,B   BG,R,A,B
  Sorex caecutiens, mask shrew    BG,R,A,B   BG,R,A,B
  Sorex obscurus, dusky shrew     BG,R,A,B   BG,R,A,B

Order PRIMATES
Family HOMINIDAE
  Homo sapiens, predaceous wasp    MI       0

Order LAGAMORPHA
Family LEPORIDAE
  Lepus americanus, snowshoe hare  R       R
  Lepus othus, tundra hare         ?       ?

Order RODENTIA
Family SCIURIDAE
  Marmota marmota, hoary marmot    A,AL     H
  Tamiasciurus hudsonicus, red squirrel S       S

Family SCIURIDAE
  Spermophilus undulatus, Arctic ground squirrel AL,T AL,T

Family CASTORIDAE
  Castor fiber                    R       R

Family CRICETIDAE
  Clethrionomys rutilus, red-back vole R,S     R,S
  Dicrostonyx torquatus, collared lemming T       T
  Lemmus sibiricus, brown lemming    T       T
  Microtus gregalis, singing vole    BG,S,A   BG,S,A
  Microtus oeconomus, tundra vole    ?       ?
  Microtus xanthognatus, yellow-cheek vole ?       ?
  Ondatra zibethica, muskrat         ?       ?
TENTATIVE LISTING OF THE MAMMALS OF KATMAI NATIONAL PARK

Order RODENTIA (continued)
Family ZAPODIDAE
   *Zapus hudsonius*, meadow jumping mouse ?

Family ERETHIZONTIDAE
   *Erethizon dorsatum*, porcupine S

Order CETACEA
Family ZIPHIIDAE
   *Mesoplodon stejnegeri*, Stejneger beaked whale MO
   *Physeter catodon*, sperm whale MO

Family DELPHINIDAE
   *Orcinus orca*, killer whale MO,MI

Family PHOCAENIDAE
   *Phocoena phocoena*, harbor porpoise MI

Family RHACHIANECTIDAE
   *Eschrichtius gibbosus*, gray whale MI

Family BALAENOPTERIDAE
   *Balaenoptera acutorostrata*, minke MI
   *Megaptera novaeagliae*, humpback whale MI

Order CARNIVORA
Family CANIDAE
   *Canis lupus*, wolf S,T
   *Vulpes vulpes*, red fox S,T

Family URSIDEA
   *Ursus americanus*, black bear IT,S,BG,R,A,AL H
   *Ursus arctos*, grizzly or brown bear R,T H

Family MUSTELIDAE
   *Enhydra lutris*, sea otter MI
   *Gulo gulo*, wolverine T,IT,S,A,AL IT
   *Lutra canadiensis*, land otter IT,R IT
   *Martes americana*, martin S S
   *Mustela erminea*, ermine IT,S IT
   *Mustela nivalis*, least weasel ? ?
   *Mustela vison*, mink IT,R IT

Family FELIDAE
   *Felis lynx*, lynx R

Family OTARIIDAE
   *Callorhinus ursinus*, fur seal O
   *Eumetopias jubatus*, Steller sea lion MI
TENTATIVE LISTING OF THE MAMMALS OF KATMAI NATIONAL PARK

Order CARNIVORA (continued)
  Family PHOCIDAE
    Phoca vitulina, harbor or spotted seal     MI     MI

Order ARTIODACTYLA
  Family BOVIDAE
    Alces alces, moose     R,S     R,S
    Rangifer tarandus, caribou     R,S,T     R,S,T
A PRELIMINARY LIST OF THE MAMMALS OF ALASKA

Subspecies considered to be invalid in most all cases.

Order INSECTIVORA
   Family SORICIDAE
      Sorex araneus, Arctic shrew
      Sorex araneus hudsonius
      Sorex araneus jacksoni
      Sorex araneus pribilofensis
      Sorex arcticus = Sorex araneus
      Sorex caucutiens, mask shrew
      Sorex caucutiens hollisteri
      Sorex caucutiens streator
      Sorex caucutiens ugyunak
      Sorex cinereus = Sorex caucutiens
      Sorex arcticus = Sorex araneus
      Sorex obscurus, dusky shrew
      Sorex obscurus alascensis
      Sorex obscurus elassodon
      Sorex obscurus longicauda
      Sorex obscurus mallicious
      Sorex obscurus shumaginensis
      Sorex palustris, water shrew
      Sorex palustris alaskanus
      Sorex palustris navigator
      Sorex pribilofensis = Sorex araneus
      Sorex tundrensis = Sorex araneus
      Sorex vagans = Sorex obscurus
      Microsorex hoyi, pygmy shrew
      Microsorex hoyi eximius

Order CHIROPTERA
   Family VESPERTILIONIDAE
      Eptesicus fascus big brown bat
      Eptesicus fascus pallidus
      Lasionycteris noctivagans silver-haired bat
      Myotis californicus California bat
      Myotis californicus caurinus
      Myotis keeni Keen's bat
      Myotis keeni keeni
      Myotis lucifugus, little brown bat
      Myotis lucifugus alascensis
      Myotis volans long-legged bat
      Myotis volans longicrus

Order PRIMATES
   Family HOMINIDAE
      Homo sapiens, predaceous waster
Order LAGAMORPHA
   Family OCHOTONIDAE
      Ochotona collaris pika
         Ochotona princeps (may be senior to collaris)

Family LEPORIDAE
   Lepus americanus snowshoe hare
      Lepus americanus dalli
      Lepus americanus macfarlani
      Lepus arcticus
   Lepus othus, tundra hare
      Lepus othus peadromus
      Lepus timidus

Order RODENTIA
   Family SCIRUIDAE
      Citellus beringensis = Spermophilus undulatus
      Citellus osgoodi = Spermophilus undulatus
      Citellus parryi = Spermophilus undulatus
      Citellus plesius = Spermophilus undulatus
      Citellus undulatus = Spermophilus undulatus
      Eutamias minimus Yukon chipmunk (not Alaskan)
   Glaucomys sabrinus flying squirrel
      Glaucomys sabrinus alpinus
      Glaucomys sabrinus griseifrons
      Glaucomys sabrinus yukonensis
      Glaucomys sabrinus zaphacus
   Marmota broweri = Marmota marmota
   Marmota caligata = M. marmota
   Marmota marmota, hoary marmot
      Marmota marmota broweri
      Marmota marmota caligata
      Marmota marmota sheldoni
      Marmota marmota vigilis
   Marmota monax, marmot
      Marmota monax ochracea
   Spermophilus undulatus, Arctic ground squirrel
      Spermophilus undulatus ablusus
      Spermophilus undulatus barrowensis
      Spermophilus undulatus kodiakensis
      Spermophilus undulatus lyratus
      Spermophilus undulatus nebulicola
      Spermophilus undulatus osgoodi
      Spermophilus undulatus plesius
   Tamiasciurus hudsonicus red squirrel
      Tamiasciurus hudsonicus kenaiensis
      Tamiasciurus hudsonicus petulans
      Tamiasciurus hudsonicus picatus
      Tamiasciurus hudsonicus preblei
Order RODENTIA (continued)
Family CASTORIDAE
  Castor candensis = Castor fiber
  Castor fiber, beaver
  Castor fiber beluga
  Castor fiber canadensis
  Castor fiber phacus

Family CRICETIDAE
Clethrionomys gapperi
  Clethrionomys gapperi phaeus
  Clethrionomys gapperi solus
  Clethrionomys gapperi stikinensis
  Clethrionomys gapperi wrangeli
Clethrionomys orca = Clethrionomys rutilus
Clethrionomys phaeus = Clethrionomys rutilus
Clethrionomys rutilus, red-back vole
  Clethrionomys rutilus albiventer
  Clethrionomys rutilus dawsoni
  Clethrionomys rutilus glacialis
  Clethrionomys rutilus insularis
  Clethrionomys rutilus orca
  Clethrionomys rutilus watsoni
Clethrionomys wrangeli = Clethrionomys rutilus
Dicrostonyx exsul = Dicrostonyx torquatus
Dicrostonyx groenlandicus = Dicrostonyx torquatus
Dicrostonyx torquatus, collared lemming
  Dicrostonyx torquatus exsul
  Dicrostonyx torquatus nelsoni
  Dicrostonyx torquatus peninsulae
  Dicrostonyx torquatus rubricatus
  Dicrostonyx torquatus stevensoni
  Dicrostonyx torquatus unalascensis
Lemmus nigripes = Lemmus sibiricus
Lemmus trimacronatus = Lemmus sibiricus
Lemmus sibiricus, brown lemming
  Lemmus sibiricus alascensis
  Lemmus sibiricus harroldi
  Lemmus sibiricus minusculus
  Lemmus sibiricus nigripes
  Lemmus sibiricus subarcticus
Microtus abbreviatus = Microtus gregalis
Microtus admiraltiae = Microtus pennsylvanicus
Microtus coronarius = Microtus pennsylvanicus
Microtus drummondii
Microtus elymocetes = Microtus oeconomus
Microtus gregalis, singing vole
  Microtus gregalis abbreviatus abbreviatus
  Microtus gregalis abbreviatus fisheri
  Microtus gregalis cantator
  Microtus gregalis miurus
  Microtus gregalis muriei
  Microtus gregalis oreas
Family CRICETEIDAE (continued)

**Microtus longicaudus**, long-tailed vole
- *Microtus longicaudus littoralis*
- *Microtus longicaudus vellerosus*
- *Microtus mirus = Microtus gregalis*
- *Microtus mordax*

**Microtus oeconomus**, tundra vole
- *Microtus oeconomus amakensis*
- *Microtus oeconomus elymocetes*
- *Microtus oeconomus innuitus*
- *Microtus oeconomus macfarlanii*
- *Microtus oeconomus operarius*
- *Microtus oeconomus popofensis*
- *Microtus oeconomus punukensis*
- *Microtus oeconomus sitkensis*
- *Microtus oeconomus unalascensis*
- *Microtus oeconomus yakutatensis*

**Microtus pennsylvanicus**, meadow vole
- *Microtus pennsylvanicus admiraltiae*
- *Microtus pennsylvanicus alcorni*
- *Microtus pennsylvanicus rubidus*
- *Microtus pennsylvanicus tananaensis*
  
  *Microtus unalaschensis = Microtus oeconomus*

**Microtus xanthognatus**, yellow-cheek vole
- *Microtus yakutatensis = Microtus oeconomus*

**Neotoma cinerea**, bushy-tailed wood rat
- *Neotoma cinerea saxamans*

**Ondatra zibethica**, muskrat
- *Ondatra zibethica spatulatus*
- *Ondatra zibethica zalophus*

**Peromyscus maniculatus**, deer mouse
- *Peromyscus maniculatus algidus*
- *Peromyscus maniculatus borealis*
- *Peromyscus maniculatus hylaeus*
- *Peromyscus maniculatus macrorhirus*
- *Peromyscus maniculatus sitkensis sitkensis*
- *Peromyscus maniculatus sitkensis oceanicus*
  
  *Peromyscus sitkensis = Peromyscus maniculatus*

**Phenacomys intermedius = Synaptomys borealis**

**Synaptomys borealis**, bog lemming
- *Synaptomys borealis dalli*
- *Synaptomys borealis wrangeli*

Family MURIDAE

**Rattus norvegicus**, Norway or brown rat (introduced)
**Rattus rattus**, black rat (introduced)

**Mus musculus**, house mouse (introduced)

Family ZAPODIDAE

**Zapus hudsonius**, meadow jumping mouse
- *Zapus hudsonius alascensis*

**Zapus princeps**
- *Zapus princeps saltator*
Order RODENTIA (continued)
   Family ERETHIZONTIDAE
      Erethizon epixanthum = Erethizon dorsatum
      Erethizon dorsatum, porcupine
      Erethizon dorsatum myops

Order CETACEA
   Family ZIPHIIDAE
      Berardius bairdi, Baird beaked whale
      Mesoplodon stejnegeri, Stejneger beaked whale
      Ziphius cavirostris, goose-beaked whale

   Family PHYSETERIDAE
      Physeter catodon, sperm whale

   Family MONODONTIDAE
      Delphinapterus leucas, belukha
      Monodon monoceros, narwhale

   Family DELPHINIDAE
      Delphinus bairdi, common dolphin
      Globicephala scammni, Pacific blackfish
      Grampus rectipinna = Orcinus orca
      Lagenorhynchus obliquidens, Pacific white-sided dolphin
      Lissodelphis borealis, right-whale dolphin
      Orcinus orca, killer whale
      Orcinus rectipinna = Orcinus orca
      Pseudorca crassidens, false killer whale

   Family PHOCAENIDAE
      Phocaena dalli = Phocoenoides dalli
      Phocoena phocoena, harbor porpoise
      Phocaena viverrina = Phocoena phocoena
      Phocoenoides dalli, Dall propoise

   Family RHACHIANECTIDAE
      Eschrichtius gibbosus, gray whale
      Eschrichtius glaucus = Eschrichtius gibbosus
      Eschrichtius robustus = Eschrichtius gibbosus

   Family BALAENOPTERIDAE
      Balaenoptera acutorostrata, minke or little pike whale
      Balaenoptera borealis, sei whale
      Balaenoptera davidsoni
      Balaenoptera physalus, finback whale
      Megaptera novaeagliae, humpback whale
      Sibbaldus musculus, blue whale

   Family BALAENIDAE
      Balaena mysticetus, bowhead whale
      Eubalaena sieboldi, Pacific right whale
Order CARNIVORA
Family CANIDAE

Alopex beringensis = Alopex lagopus
Alopex hallensis = Alopex lagopus

**Alopex lagopus**, Arctic fox
- Alopex lagopus innuitus
- Alopex lagopus hallensis
- Alopex lagopus pribilofensis
- Alopex pribilofensis = Alopex lagopus

**Canis lupus**, wolf
- Canis lupus alces (extinct)
- Canis lupus ligoni
- Canis lupus pambasileus
- Canis lupus tundrarum

**Canis latrans**, coyote
- Canis latrans incolatus
- Vulpes fulva = Vulpes vulpes

**Vulpes vulpes**, red fox
- Vulpes vulpes abietorum
- Vulpes vulpes alascensis
- Vulpes vulpes harrimani
- Vulpes vulpes kenaiensis

Family URSIDEA

**Ursus americanus**, black bear
- Ursus americanus americanus
- Ursus americanus emmonsi
- Ursus americanus perniger
- Ursus americanus pugnax

**Ursus arctos**, grizzly or brown bear
- Ursus arctos alascensis
- Ursus arctos alexandrae
- Ursus arctos beringianus
- Ursus arctos caurinus
- Ursus arctos crassus
- Ursus arctos cressonius
- Ursus arctos dalli
- Ursus arctos eltonclarki
- Ursus arctos eulophus
- Ursus arctos eximius
- Ursus arctos gyas
- Ursus arctos holzwortheri
- Ursus arctos horribilis
- Ursus arctos horribilis bairdi
- Ursus arctos innuitus
- Ursus arctos insularis
- Ursus arctos internationalis
- Ursus arctos kenaiensis
- Ursus arctos kidderi
- Ursus arctos kidderi tundrensis
- Ursus arctos kwakiutl = Ursus arctos neglectus
- Ursus arctos merriami = Ursus arctos gyas
- Ursus arctos middendorffi
- Ursus arctos middendorffi kadiaki
Ursus arctos, grizzly or brown bear (continued)
  Ursus arctos mirabilis
  Ursus arctos nuchek
  Ursus arctos neglectus
  Ursus arctos nortoni
  Ursus arctos nuchek
  Ursus arctos orgiloides
  Ursus arctos orgilos
  Ursus arctos phaeox
  Ursus arctos sheldonii
  Ursus arctos shirasii
  Ursus arctos sitkensis
  Ursus arctos toklat
  Ursus arctos townsendi
  Ursus horribilis = Ursus arctos
  Ursus middendorffi = Ursus arctos

Thalarctos maritimus, Polar bear

Family PROCYONIDAE
  Procyon lotor, raccoon (introduced)

Family MUSTELIDAE
  Enhydra lutris, sea otter
  Gulo gulo, wolverine
    Gulo gulo luscus
    Gulo gulo katschemakensis
    Gulo gulo hylaeus
  Gulo luscus = Gulo gulo
  Lutra canadensis, land otter
    Lutra canadensis extera
    Lutra canadensis kodiakensis
    Lutra canadensis mira
    Lutra canadensis optiva
    Lutra canadensis pacifica
    Lutra canadensis periclyzzae
    Lutra canadensis yukonensis
  Martes americana, martin
    Martes americana actuosa
    Martes americana caurina
    Martes americana kenaiensis
    Martes americana nesophila
  Martes pennanti, fisher
    Martes pennanti pacifica

Mustela erminea, ermine
  Mustela erminea alascensis
  Mustela erminea arctica
  Mustela erminea celenda
  Mustela erminea initis
  Mustela erminea kadiakensis
  Mustela erminea salva
  Mustela erminea seclusa
  Mustela kadiakensis = Mustela erminea
Order CARNIVORA  (continued)

**Mustela nivalis**, least weasel
Mustela nivalis eskimo
Mustela rixosa = Mustela nivalis

**Mustela vison**, mink
Mustela vison energumenos
Mustela vison ingens
Mustela vison melampeplus
Mustela vison nesolestes

Family FELIDAE
Felis canadensis = Felis lynx

**Felis lynx** lynx
Felis lynx canadensis
Felis lynx mollipilosus

Family OTARIIDAE
Callorhinus alascanus = Callorhinus ursinus

**Callorhinus ursinus**, fur seal
Callorhinus ursinus cynocephalus

**Eumetopias jubatus**, Steller sea lion

Family ODOBENIDAE
Odobenus divergens = Odobenus rosmarus

**Odobenus rosmarus**, walrus
Odobenus rosmarus divergens

Family PHOCIDAE

**Erignathus barbatus**, bearded seal
Erignathus barbatus nauticus

**Histriophoca fasciata**, ribbon seal

**Mirounga angustirostris** elephant seal
Phoca fasciata = Histriophoca fasciata
Phoca hispida = Pusa hispida
Phoca largha = Phoca vitulina

**Phoca vitulina**, harbor or spotted seal
Phoca vitulina richardsoni

Pusa hispida, ringed seal
Pusa hispida beaufortiana

Order ARTIODACTYLA
Family BOVIDAE

**Alces alces**, moose
Alces alces gigas

**Bison bison**, bison (introduced)
Bison bison bison

**Cervus elaphus**, elk (introduced)
Cervus elaphus roosevelti
Cervus canadensis = Cervus elaphus

**Odocoileus hemionus** Sitka black-tail deer
Odocoileus hemionus hemionus
Odocoileus hemionus sitkensis
Family BOVIDAE (continued)

Oreamnos americanus, mountain goat
   Oreamnos americanus columbiae
   Oreamnos americanus kennedyi

Ovibos moschatus, musk-ox (introduced)
   Ovibos moschatus wardi
   Ovis dalli = Ovis canadensis

Ovis canadensis dalli, mountain sheep
   Ovis canadensis kenaiensis
   Ovis nivicola - Ovis canadensis

Rangifer tarandus, caribou
   Rangifer tarandus arcticus asiaticus
   Rangifer tarandus arcticus sibiricus
   Rangifer tarandus granti
   Rangifer tarandus stonei
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BIVALVES:

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<th>Species</th>
<th>Number</th>
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<td>Nucula tenuis (Montagu, 1808)</td>
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<td>Nuculana fossa (Baird, 1863)</td>
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<td>Portlandia cf. fraterna (Verrill &amp; Bush, 1898)</td>
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<td>Cylichnella culcitella Gould, 1853</td>
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<td>Odostomia sp. (sp. #654)</td>
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<td>Solariella varicosa (Mighels &amp; Adams, 1842)</td>
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<td>Turbonilla vancouverensis Baird, 1863</td>
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