



Intertidal Fish Inventory of Ebey's Landing National Historical Reserve (2005)

Natural Resource Technical Report NPS/NCCN/NRTR—2011/453



ON THE COVER

Perego's Lake and the Admiralty Inlet shoreline
Photograph by: S. Fradkin

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Executive Summary

In May 2005, Coastal and Fisheries staff from Olympic National Park conducted a 3-day inventory of intertidal fishes adjacent to the shoreline of Ebey's Landing National Historical Reserve. Beach seine sampling was employed in all intertidal habitats on both the Admiralty Inlet and Penn Cove shorelines. A total of 31 locations were sampled, resulting in documentation of 28 species. The habitats in both of these regions include sand, gravel, cobble, and boulder beaches. Fish community composition in both regions was dominated by juvenile salmon, particularly chum salmon smolts, however the communities in each region were significantly different from each other. These differences likely reflect the physical habitat differences between the open coastline of Admiralty Inlet and the protected Penn Cove.

Acknowledgments

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Introduction

Program Scope

In 1998, Congress passed the National Parks Omnibus Management Act that recognized the need for credible scientific information to manage parks. In recognition of the general lack of basic information on what biological resources occur in parks and what the status of the resources are, the act mandated that the NPS establish an inventory and monitoring program to establish baseline information and to provide information on the long-term trends in condition of National Park System resources. The resultant congressionally funded Service-wide Inventory and Monitoring (I&M) Program provides funds to park Networks, such as the North Coast and Cascades Network (NCCN) to conduct biological inventories and long-term monitoring (NPS 1999). The basic goal of the inventory portion of the program is to document through existing data and targeted field investigations the occurrence of at least 90 percent of the species of vertebrates and vascular plants currently estimated to occur in the park. The I&M program views inventories as iterative processes, whereby an initial effort is conducted, after which further additions and refinements to these initial inventories can be made during more in-depth investigations funded by various sources, including the national program. The effort described in this report represents an initial effort to inventory the intertidal fishes associated with the shoreline adjacent to Ebey's Landing National Historical Reserve (EBLA).

Objectives

The effort described in this report represents an initial effort to inventory the intertidal fishes of the Ebey's Landing National Historical Reserve (EBLA). From this inventory, the fish communities of the Admiralty Inlet and Penn Cove shorelines were compared, and the number of possible species present in the overall study area at the time of sampling was estimated. This inventory does not represent an accurate assessment of fish assemblage structure across different seasons or between years; rather it represents the assemblage structure found during the limited sampling period.

Site Description

Ebey's Landing National Historical Reserve was created by Congress in 1978 to "preserve and protect a rural community which provides an unbroken historic record from... 19th century exploration and settlement in Puget Sound to the present time". Located on central Whidbey Island, most of the 17,400 acre reserve remains in private ownership and is administered by a nine-member Trust Board. Whidbey Island lies at the extreme north end of Puget Sound and forms the eastern Boundary of the Strait of Juan de Fuca.

The Reserve boundary encompasses broad fertile prairies, rolling woodlands, shallow brackish lakes, high seaside bluffs, and a deep protected cove. The western shore of the Reserve is an eight-mile strip of narrow sandy/gravel beach that gives way to dramatic bluffs and low ravines. This shoreline is lightly developed. The eastern shore of the Reserve encompasses the shoreline associated with the 1,619 hectare Penn Cove. This shoreline is highly developed, including the town of Coupeville, and is the site of intense aquaculture (mussel) activity.

Methods

EBLA intertidal fish sampling was conducted by Olympic National Park Natural Resources Staff from May 3-5, 2005. Representative habitats on the Admiralty Inlet and Penn Cove Shorelines were systematically sampled at approximate regular intervals that ensured all major habitats were included. Sites sampled appear in Figure 1, with detailed geographic data appearing in Appendix 1. The shoreline of EBLA consists of sand, gravel, cobble, and boulder beaches, with no distinct tidepool habitat.



Figure 1. Location of Ebey's Landing National Historical Reserve on Whidbey Island, WA. Location of sampling sites on the western Admiralty Inlet and eastern Penn Cove shorelines.

All intertidal sampling was conducted using a beach seine specially designed for use on rocky/gravel shores. The 120 ft variable mesh seine consists of 33-ft wings of 1.24" white mesh nylon and a 54 ft center section of 0.25" green nylon mesh. The 2.5 ft leading edge (lead line) of the 10 ft deep central panel is constructed of hypolon material enabling the seine to slide over obstacles such as rocks, etc. The seine was set using a "round haul" technique (Figure 2). One end of the seine was held on the beach with the opposite end attached to a 15 ft Zodiac skiff. The skiff then backed perpendicular from the shore until the entire net was played out. The skiff then headed toward shore, forming an arc, closing the seine approximately 54 ft from the starting point. The seine was then pulled to shore by hand by 5 staff members. All fish were identified to species level and enumerated. Similar nets used in this fashion are approximately 95% efficient at capturing epibenthic fish (i.e. those living on the surface of the ocean bottom) within the seined area (Murphy et al. 2000). All sampling occurred diurnally when tidal elevations were between 0.3 and 6.8 ft above mean lower low water. At each sampling site, substrate type was qualitatively determined.



Figure 2. “Round haul” beach seining on the Admiralty Inlet shoreline associated with Ebey’s Landing National Historical Reserve.

For each species captured, representative voucher specimens were collected and preserved in the field in 70 percent ethanol. Once back at the OLYM Lake Crescent Natural Resources Laboratory, all voucher specimen identities were verified (using Clemens and Wilby 1946, Hart 1973, Lea and Miller 1972, and Lamb and Edgell 1986), the specimens were fixed in formalin, labeled and stored in 95 percent ethanol. All specimens have been accessioned into the OLYM collection.

Comparisons of intertidal fish community structure were made between regions (Admiralty Inlet and Penn Cove). Data were analyzed using the multivariate methods of Clarke (1993), Clarke and Warwick (2001), and PRIMER V6 software (Clarke and Gorely, 2001). Fish frequency and abundance data were grouped by site and fourth root transformed to accommodate high and low values in subsequent analyses. Bray-Curtis similarities were generated and non-metric multidimensional scaling (MDS) was performed. Similarity percentage analyses (SIMPER) were used to identify fish taxa contributing most to the average similarity within regions. Analysis of similarity (ANOSIM) was used to test the significance of differences between regions.

Results and Discussion

A total of 31 locations were sampled on the Admiralty Inlet and Penn Cove shorelines, resulting in the documentation of 28 intertidal fish species. These species included baitfish (larval smelt, larval herring, sand lance), surfperch, flatfish, gunnels, sculpin, and salmonids (Table 1). Representative species observed are illustrated in Figure 3.



Figure 3. Representative species sampled during the Ebey's Landing National Historical Reserve Intertidal Fish Inventory in May 2005.

A) arrow goby (*Clevelandia ios*), B) chum salmon (*Oncorhynchus keta*), C) coho salmon (*Oncorhynchus kisutch*), D) saddleback gunnel (*Pholis ornate*), E) smooth alligator fish (*Anoplagonus inermis*), F) butter sole (*Isopsetta isolepis*), G) shiner perch (*Cymatogaster aggregate*), H) starry flounder (*Platichthys stellatus*).

Table 1. Intertidal fish species contribution to community structure in each Ebey's Landing National Historical Reserve region as determined by SIMPER analysis.

Region	Species	Average Abundance	Average Similarity	Similarity SD	Percent Contribution	Cumulative Percent
Admiralty Inlet	ONKE	1.34	12.44	0.72	62.95	62.95
	AMHE	0.78	2.31	0.32	11.71	74.66
	THCH	0.5	2.23	0.3	11.28	85.95
	GAAC	0.56	2.09	0.32	10.6	96.54
Penn Cove	ONKE	1.7	16.59	0.96	51.22	51.22
	CYAG	1.69	12.85	0.65	39.67	90.89

A species accumulation curve base on bootstrapped sampling data was constructed using PRIMER V6 (Figure 4) illustrates an asymptotic approach at approximately 40 species. This suggests that approximately 70 percent of the species present in the intertidal areas sampled that are susceptible to capture by beach seining were documented. However, this study was only conducted during a short period in May 2005. Many other species that possibly use the intertidal at other times of the year are likely unaccounted for in this brief inventory. Thus, the apparent 70 percent species documentation likely falls well short of the 90 percent goal of the I&M Inventories program. The intertidal zone is a harsh environment to work in, and few established techniques currently exist (Gibson 1999). Beach seining is the major viable technique available.

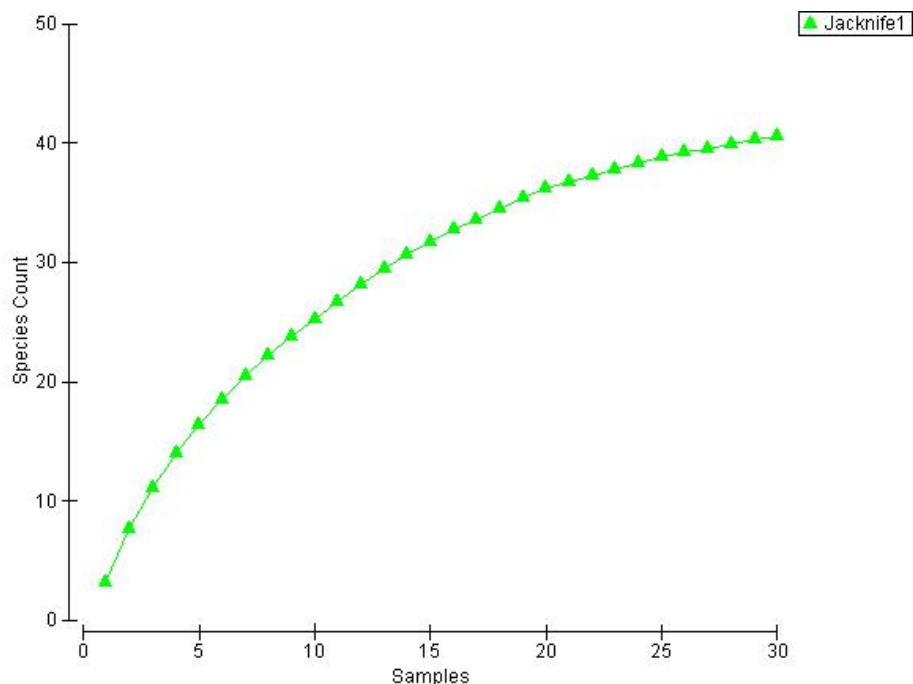


Figure 4. Ebey's Landing National Historical Reserve intertidal fish species accumulation curve for both the Admiralty Inlet and Penn Cove regions using a Jack-knife estimation procedure.

An Analysis of Similarity (ANOSIM) and MDS plots demonstrated intertidal fish community structure to be significantly different ($p=0.011$) between the two major park shoreline regions, Admiralty Inlet and Penn Cove (Figure 5). In Admiralty Inlet the dominant species group consisted of chum salmon (ONKE), sand lance (AMHE), walleye pollack (THCH), and 3-spined sticklebacks (GAAC), where chum salmon smolts dominated the community composition (Table 2). In Penn Cove, two species were the dominant community constituents, chum salmon (ONKE) and shiner surfperch (CYAG). The dominance by chum salmon smolts illustrates a likely artifact of the sampling period. During this time, out-migrating smolts were abundant in nearshore areas of Whidbey Island, however at different times of the year (i.e. winter) one would expect salmonids to contribute far less of the community composition. The Admiralty Inlet shoreline is more exposed to wave action, while the Penn Cove region is relatively sheltered. These different physical regimes likely play an important role in defining fish community structure as was evidenced by the significant differences observed between the two regions. Future inventory work at EBLA should target the same sampling sites across different seasons to detect species that are seasonally present and to assess the community structure when salmonids are less dominant.

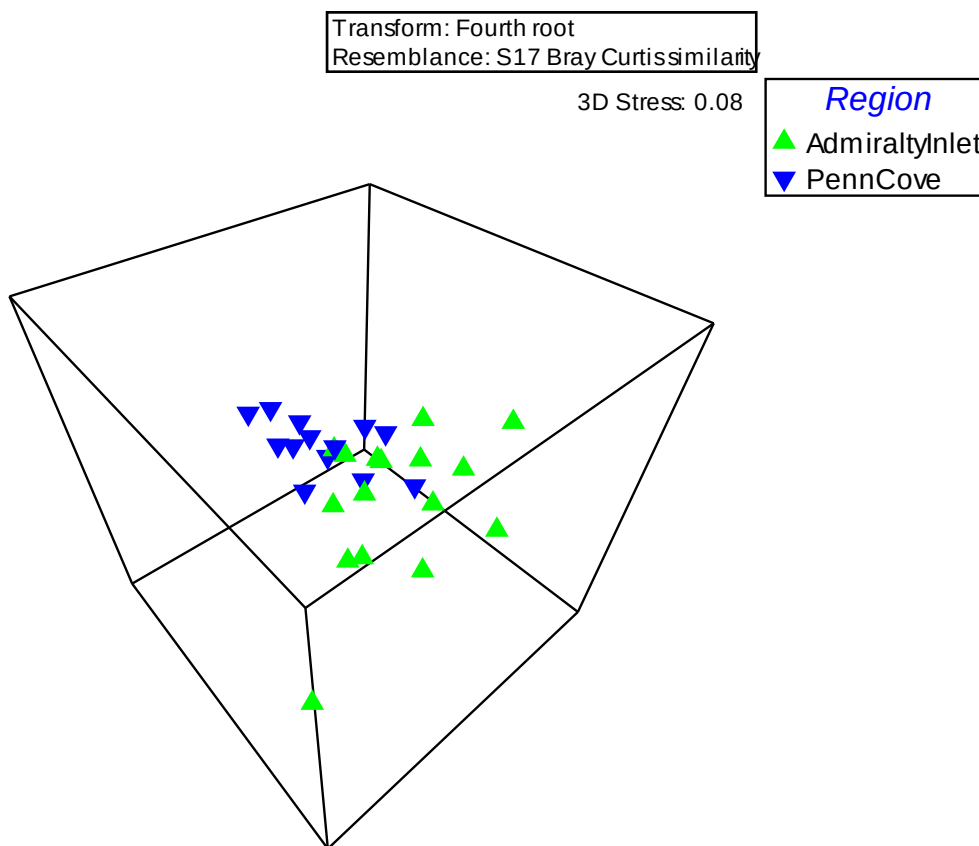


Figure 5. Non-metric Multidimensional Scaling (MDS) ordination from Bray-Curtis similarities computed for fourth-root transformed species abundances at each sampling site (MDS stress=0.07). Unique symbols denote sampling sites within Ebey's Landing National Historical Reserve regions (Admiralty Inlet & Penn Cove). An analysis of similarity (ANOSIM) showed a significant difference in community composition between regions (Global R=0.153, $p=0.011$, 999 permutations).

Table 2. Species codes, scientific names, and common names of fish documented in the intertidal zone associated with Ebey's Landing National Historical Reserve during the May 2007 inventory.

Species Code	Scientific Name	Common Name
AMHE	<i>Ammodytes hexapterus</i>	Pacific Sandlance
ANIN	<i>Anoplagonus inermis</i>	Smooth Alligatorfish
CLAC	<i>Clinocottus acuticeps</i>	Sharpnose Sculpin
CLIO	<i>Clevelandia ios</i>	Arrow Goby
COAS	<i>Cottus Asper</i>	Prickly Sculpin
CYAG	<i>Cymatogaster aggregata</i>	Shiner Surfperch
ENBI	<i>Enophrys bison</i>	Buffalo Sculpin
GAAC	<i>Gasterosteus aculeatus</i>	Threespine Stickleback
HYPR	<i>Hypomesus pretiosus</i>	Surf Smelt
ICBO	<i>Icelinus borealis</i>	Northern Sculpin
ISIS	<i>Isopsetta isolepis</i>	Butter Sole
LEAR	<i>Leptocottus armatus</i>	Staghorn Sculpin
MIPR	<i>Microgadus proximus</i>	Pacific Tomcod
MYPO	<i>Myoxocephalus polyacanthocephalus</i>	Great Sculpin
OLMA	<i>Oligocottus maculosus</i>	Tidepool Sculpin
ONKE	<i>Oncorhynchus keta</i>	Chum Salmon
ONKI	<i>Oncorhynchus kisutch</i>	Coho Salmon
ONTS	<i>Oncorhynchus tshawytscha</i>	Chinook Salmon
OPEL	<i>Ophiodon elongatus</i>	Lingcod
OSME	<i>Osmeridae</i>	larval smelt
PHOR	<i>Pholis ornata</i>	Saddleback Gunnel
PLST	<i>Platichthys stellatus</i>	Starry Flounder
SACL	<i>Salmo clarki</i>	Cutthroat trout
SYLE	<i>Syngnathus leptorhynchus</i>	Bay Pipefish
THCH	<i>Theragra chalcogramma</i>	Walleye Pollock
TRTR	<i>Trichodon trichodon</i>	Pacific Sandfish

Literature Cited

- Clarke, K. R. 1993. A non-parametric multivariate analysis of changes in community structure. *Australian Journal of Ecology* 18:117–143.
- Clarke, K. R. and Gorley, R. N. 2001. PRIMER v5: User manual/tutorial. PRIMER-E Ltd., Plymouth, UK.
- Clarke, K. R. and Warwick, R. M. 2001. A further biodiversity index applicable to species lists: Variation in taxonomic distinctness. *Marine Ecology Progress Series* 216:265–278.
- Clemens, W. A. and Wilby, G. V. 1946. Fishes of the Pacific coast of Canada. *Bulletin of the Fisheries Research Board of Canada* 68.
- Gibson, R. N. 1999. Methods for studying intertidal fishes. Pages 7–25 in M. H. Horn, K. L. M. Martin, and M. A. Chotkowski, editors. *Intertidal fishes: Life in two worlds*. Academic Press, San Diego.
- Hart, J. L. 1973. Pacific Fishes of Canada. *Bulletin of the Fisheries Research Board of Canada* 180.
- Lea, R. N. and D. J. Miller. 1972. Guide to the coastal marine fishes of California. *California Fish Bulletin* 157. University of California.
- Lamb, A. and P. Edgell. 1986. Coastal fishes of the Pacific Northwest. Harbor Publishing, Maderia Park, BC, Canada.
- Murphy, M. L., Johnson, S. W., and D. J. Csepp. 2000. A comparison of fish assemblages in eelgrass and adjacent subtidal habitats near Craig, Alaska. *Alaska Fishery Research Bulletin* 7:11–21.
- National Park Service. 1999. Natural resource challenge: The National Park Service's action plan for preserving natural resources. NPS Natural Resources Information Division. Fort Collins, Colorado.

Appendix 1. Sampling Coordinates, Species Abundance, and Substrate Classes Associated with Sampling Locations

Region	Site	Taxon_ID	Substrate	# In Net	UTM East	UTM North
Admiralty Inlet	WAYPOINT002	CYAG	Cobble	18	517183	5341525
	WAYPOINT002	GAAC	Cobble	1		
	WAYPOINT002	OLMA	Cobble	1		
	WAYPOINT002	ONKE	Cobble	5		
	WAYPOINT003	ONKE	Cobble	250	517202	5341266
	WAYPOINT004	GAAC	Boulder	20	517227	5341014
	WAYPOINT004	ONKE	Boulder	85		
	WAYPOINT005	GAAC	Cobble	8	517487	5340481
	WAYPOINT005	ONKE	Cobble	30		
	WAYPOINT005	TRTR	Cobble	1		
	WAYPOINT006	ONKE	Cobble	4	519012	5339478
	WAYPOINT007	ONKE	Gravel	21	519215	5339324
	WAYPOINT007	THCH	Gravel	2		
	WAYPOINT008	ONKE	Cobble	2	519762	5338392
	WAYPOINT008	OSME	Cobble	41		
	WAYPOINT008	THCH	Cobble	11		
	WAYPOINT009	HYPR	Gravel	9	520676	5337986
	WAYPOINT009	MYPO	Gravel	1		
	WAYPOINT009	ONKE	Gravel	1		
	WAYPOINT010	OSME	Gravel	4	522157	5337024
	WAYPOINT011	AMHE	Gravel	154	522545	5336585
	WAYPOINT011	MIPR	Gravel	1		
	WAYPOINT011	ONKE	Gravel	61		
	WAYPOINT011	THCH	Gravel	2		
	WAYPOINT012	STYLE	Gravel	1	523386	5335589
	WAYPOINT013	AMHE	Sand & Gravel	1	523623	5334708
	WAYPOINT013	GAAC	Sand & Gravel	61		
	WAYPOINT013	ISIS	Sand & Gravel	1		
	WAYPOINT013	ONKE	Sand & Gravel	3		
	WAYPOINT013	OPEL	Sand & Gravel	2		
	WAYPOINT013	THCH	Sand & Gravel	2		
	WAYPOINT014	AMHE	Sand & Gravel	5	523715	5333939
	WAYPOINT015	AMHE	Gravel	1	523960	5333329

Appendix 1. Sampling Coordinates, Species Abundance, and Substrate Classes Associated with Sampling Locations (continued).

	WAYPOINT015	GAAC	Gravel	1		
	WAYPOINT015	THCH	Gravel	1		
	WAYPOINT016	THCH	Gravel	23	524786	5333810
	WAYPOINT017	AMHE	Sand & Gravel	350	525563	5334174
	WAYPOINT017	ANIN	Sand & Gravel	1		
	WAYPOINT017	ARLA	Sand & Gravel	17		
	WAYPOINT017	COAS	Sand & Gravel	1		
	WAYPOINT017	ENBI	Sand & Gravel	1		
	WAYPOINT017	GAAC	Sand & Gravel	1		
	WAYPOINT017	ICBO	Sand & Gravel	1		
	WAYPOINT017	MYPO	Sand & Gravel	1		
	WAYPOINT017	THCH	Sand & Gravel	1		
	WAYPOINT018	AMHE	Gravel	12	526801	5334359
	WAYPOINT018	BLCI	Gravel	1		
	WAYPOINT018	MYPO	Gravel	1		
	WAYPOINT018	OLMA	Gravel	3		
	WAYPOINT018	ONKE	Gravel	18		
	WAYPOINT018	PHOR	Boulder	1		
Penn Cove	WAYPOINT019	ISIS	Boulder	1	525642	5343588
	WAYPOINT019	ONKE	Boulder	173		
	WAYPOINT019	PLST	Boulder	1		
	WAYPOINT020	CYAG	Cobble	1	525034	5343066
	WAYPOINT020	GAAC	Cobble	1		
	WAYPOINT020	LEAR	Cobble	1		
	WAYPOINT020	ONKE	Cobble	1		
	WAYPOINT020	PHOR	Cobble	1		
	WAYPOINT020	PLST	Cobble	1		
	WAYPOINT021	CYAG	Cobble	535	523148	5342611
	WAYPOINT021	ONKE	Cobble	115		
	WAYPOINT021	SACL	Cobble	1		
	WAYPOINT022	CYAG	Gravel	144	521599	5342594
	WAYPOINT023	CLIO	Gravel	1	519843	5341891
	WAYPOINT023	CYAG	Gravel	26		
	WAYPOINT023	LEAR	Gravel	13		
	WAYPOINT023	ONKI	Gravel	1		
	WAYPOINT024	CLAC	Cobble	1	520237	5340964
	WAYPOINT024	CYAG	Cobble	64		

Appendix 1. Sampling Coordinates, Species Abundance, and Substrate Classes Associated with Sampling Locations (continued).

WAYPOINT024	SACL	Cobble	1		
WAYPOINT025	AMHE	Cobble	1	520532	5340204
WAYPOINT025	GAAC	Cobble	6		
WAYPOINT025	ONKE	Cobble	1		
WAYPOINT026	CYAG	Gravel	98	521611	5339946
WAYPOINT026	ONKE	Gravel	49		
WAYPOINT027	CYAG	Cobble	92	522684	5340605
WAYPOINT027	ONKE	Cobble	4		
WAYPOINT027	ONKI	Cobble	4		
WAYPOINT027	ONTS	Cobble	2		
WAYPOINT028	OLMA	Cobble	3	524382	5341024
WAYPOINT028	ONKE	Cobble	36		
WAYPOINT029	CYAG	Gravel	3	525744	5341098
WAYPOINT029	ONKE	Gravel	2		
WAYPOINT029	PLST	Gravel	1		
WAYPOINT030	CLAC	Sand & Gravel	1	523922	5342730
WAYPOINT030	GAAC	Sand & Gravel	1		
WAYPOINT030	LEAR	Sand & Gravel	1		
WAYPOINT030	ONKE	Sand & Gravel	11		
WAYPOINT030	ONTS	Sand & Gravel	7		
WAYPOINT031	OLMA	Cobble	2	527058	5340712
WAYPOINT031	ONKE	Cobble	186		

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